THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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THE PROGRESSIVE TORTOISE.

IT is a curious paradox that next to his glib assurance in contradicting the basic principles of human nature, the most conspicuous characteristic of the eloquent socialist is his lack of originality when confronted with the necessities of practical politics. We remember how in the first flush of its ardent youth the Fabian Society was widely regarded by certain worthy parties as a positive danger to the community, the expectation being that its supporters would coerce or cajole the authorities into a policy of wild experiment. But we have since had ample opportunity of observing how incapable are governing bodies of initiating industrial improvements. They can do little more than appropriate the results of private enterprise. Long ago it was left to commercial adventurers to provide gas and water supply and travelling facilities by road and rail, and only when such business was firmly established did it occur to the "Progressives" of those days that municipalities might advantageously enter upon it. The telegraph and the telephone owe their general utility entirely to private speculation, and numerous postal improvements have been forced on the Government by outside competition. Electric supply and traction had to be proved practicable by the sinful capitalist before the saintly councillor would meddle with them, except in the way of blocking the early progress of electric light to protect the municipal gasworks. And now, in 1905, we have a Fabian pamphlet before us announcing the discovery of electrical power distribution and advancing belated proposals for its development by public authorities.

There is something very refreshing in the way in which the arguments and facts adduced by the electric power companies in the past six years to obtain from Parliament the rights they now hold—arguments and facts that were fiercely contested by socialist municipalities at the time—are now calmly set forth in this Fabian pamphlet as reasons for the municipal appropriation of this department of electrical industry. For example, when we remember how scornfully it was denied that a large power company could generate and transmit electricity at a cheaper rate than the municipal traders, it is consoling to read now that "the general welfare of a locality may be endangered by inefficient power production"—as the company promoters showed long ago—"or by extortionate charges levied by a private company, whose dividends are the goal of their short-sighted ambition. Arbitrary private management of such important economic factors is far too dangerous to be permitted or allowed indefinitely to continue." At present the extortionate charges are levied by municipalities which are protected from competition. Although not either to be "permitted or allowed," it appears on another page that "the private companies have picked out the industrial eyes of Great Britain;" and rather desperate methods are needed for their recovery. As far as

we can follow the somewhat confused reasoning which connects electric power distribution not only with the "revival of canals" and "nationalised railways," but also with a "national mercantile marine," which would enable a Board of Aldermen to ruin Mr. Pierpont Morgan, the first step proposed seems to be the enlargement of City boundaries—or, perhaps, we should say rather the addition to them of the property of elasticity, for a "permanent Boundary Commission" is to be constituted, which will summarily expand or compress any town or county at any moment. "Finally, we propose a central transit and power department," and an engineering department to make "standardised machinery" (note that no inconvenient innovations will be needed when private enterprise is dead and buried), thus bringing about that "reconstruction of our electricity and transit system on some such lines as these," which "is inevitable if our country is to maintain its position amongst its better organised competitors."

Who these competitors are, except certain countries that leave electric power and traction to what our pamphleteer, with airy hooligan impudence, calls "the short-sighted stupidity of the ordinary man of business," is a Fabian secret. However, we observe that the final demand set forth in the pamphlet is for "a competent government and a public-spirited opposition" as an essential preliminary, which seems to suggest that this country must wait for cheap municipal power. In the meantime, the newspapers continue to make unpleasant remarks about the intolerably high rates that have been brought about by past Fabian folly, and the average citizen is in no mood to listen to the present whimsical propositions.

Municipal Telephones.

Our columns to-day contain reports of the proceedings of various tribunals bearing on the question of Municipal Telephony—Mr. Justice Buckley's judgement in the case of the Swansea Corporation's action for intercommunication, and the Local Government Board inquiries at Portsmouth and Brighton for additional loans. Mr. Justice Buckley's judgement is of interest as the first judicial interpretation of the Act of 1899. In giving its decision it would seem that the Court was guided by general questions and their interpretation rather than by the technical features which necessarily formed important grounds of the defence. The defendants admitted that they desired to prevent intercommunication, and the judge repeatedly refers to the evidence of their manager, who expressed his desire to prevent the intercommunication "by all legitimate means." Mr. Justice Buckley decides that the plaintiffs are entitled to a restricted intercommunication, and does not regard it as being within his province to determine the relevancy or otherwise of the defendants' contentions regarding the practical features of the intercommunication proposed. Local Government Board inquiries are sometimes considered to be of a perfunctory nature, but this is far from being the case when the inspector appointed really understands the subject that is being inquired into. The telephone inquiries which we report to-day show up by contrast the uninformed optimism of the municipal magnate and the well-informed pessimism of the Local Government Board Inspector. It is perhaps unfortunate that the reports of the Inspectors are not public documents. They might occasionally be of benefit in putting a drag on the ill-considered and ill-executed projects of local bodies. Fortunately only a very few towns have been persuaded into embarking upon telephone business, and those that have are probably now wishing that they had paid more attention to the warnings which were to be found in our columns.

The Technical Bureau.

Such is the name given to a private undertaking, the object of which is to form a lending library of scientific and technical literature. Its headquarters are Prince's Chambers, John Dalton Street, Manchester. Anyone may become a subscriber, the subscription being one guinea per year; or, in the case of students attending some recognised teaching institution, 15s. per year. Subscribers may borrow one book at a time, which will be forwarded by post; the first 10 books per year will be sent to each subscriber at the cost of the Bureau; the postage beyond this number must be defrayed by the subscriber. All return postages are to be paid by the subscriber.

At the present time the Bureau has about 500 books on Electrical and Mechanical Engineering, Civil Engineering, Sanitary Work, Architecture, &c. Further books will be added or duplicates obtained according to the demand.

In these days, when the number of technical books is legion, it is impossible for most people to possess an adequate library of their own, and one such as the Bureau possesses, or proposes to possess, should be extensively patronised.

It would be well if prospective subscribers wrote to the offices of the Bureau for rules and regulations and *a list of books at present available.*

A *bonâ fide* attempt to provide a good technical library deserves encouragement, as the usual run of free public libraries are very poorly equipped in such literature.

Boiler-House Records.

Nothing tends so directly to economy in power-house working as a continuous history of operations, scheduled in a compact and understandable form. Possibly due to the fear of complicated book-keeping, however, an efficient account of the working of a boiler-house is rarely seen. This account should cover everything from the receipt of coal to the performance of the boiler, and is more valuable if, at the conclusion of every operation, a comparison can be made of the results obtained with those which would represent cent. per cent. efficiency. For example, on receipt of a consignment of coal, the date of receipt, the name of forwarding agency, the description of coal, the number and description of truck and its nominal capacity should be noted. To guard against future claims the condition of the truck should also be observed. The reference number of the waybill and the weight of the coal listed thereon should be transferred to this schedule of particulars. If the coal is weighed on receipt, the gross, tare and net weights should be recorded, and the amount gained or lost over the listed figure. A slight variation may be caused by moisture conditions at the beginning or end of the coal's journey, but anything abnormal should be made the subject of complaint.

Though much neglected at present in power houses, the analysis of coal and ash should receive systematic attention, the former being divided into fixed carbon, volatile matter, ash and clinker, and moisture; while the latter should be split up into combustible and incombustible material. It is quite easy, unless due care is observed, for the waste from the furnace to contain half its weight of unconsumed combustible.

Passing to the boiler house, the times of use and withdrawal of each boiler should be noted, and the hours run per day recorded. The description and amount of coal used per day and the percentage of moisture found on it should be scheduled, from which the weight of the dry coal consumed may be found. The dry ash and clinker removed, and the percentage of ash in the coal, will give the total combustible used, which should be included in the daily report. The cubic feet of water pumped to the hotwell tanks should be metered and an allowance made, where necessary, for steam-trap returns, and also an estimation made of the water blown away through the boiler blow-off cocks. From this is determined the actual water evaporated per day, from which is deduced the pounds of water per pound of coal at actual temperatures and pressures. For

purposes of comparison this should also be expressed as pounds of water evaporated per pound of coal from and at 212° F., pounds water per pound of dry coal from and at 212° F., and also per pound of combustible at 212° F. The percentage of theoretical efficiency is then determined. The average temperature readings of feed water, inlet to economiser, steam trap returns, flue gases, outside air and pressure readings of steam gauge and chimney draught, complete an exhaustive daily record which, if kept in a scheduled form, facilitates reference. Every week these records should be combined into a weekly report.

Day by day, remarks should be made on the condition of the plant, repairs required and executed being specially noted. Data of the distribution of tasks to the men, if carefully kept, will aid in maintaining discipline and producing working efficiency. As soon as is possible, the engineer should establish a standard figure for costs from theoretical considerations based on a reasonable estimate of the capabilities of the plant and staff, and should every week compare the financial result of boiler-house working. A discrepancy can, by the method of scheduling weekly and daily returns, be easily traced to its source.

Advertising Methods.

In the latter part of this year the electrical industry is going to put forth its energy in a great exhibition, and for the furtherance of this laudable object the prominent men among our manufacturing and supply companies are banded together in committee. It is curious to conjecture how far the recent Gas Exhibition has been influential in galvanising the adherents to the sister illuminant to take this perfectly obvious step. The wonder is that it was not taken long ago, and it is instructive to compare the business methods of our supply companies with those in America. We admit that collections of electrical machinery have from time to time been displayed at various parts of the country to such of the outside public who cared to pay 6d. per head, but the time-limit has been in most cases very short, and there has generally been a lack of technical explanation available for the general inquirer.

This may be fittingly contrasted with the permanent exhibition kept going by the Edison Illuminating Co. of Boston. The public are liberally notified, by means of the newspapers and tramcar advertisements, that they are admitted without payment to the exhibition rooms, where they may see the latest exhibits in electrical advertising, domestic appliances, electrical distribution, electric lighting, manufacturing and liberal arts, and electric power and ventilation. There are comfortable seats for visitors, and there are always attendants present who will explain the working of any apparatus to those who want to know. Besides pamphlets on subjects, for example, such as the problem of the motor-driven sewing machine, the story of an electric automobile run, photographs and details of a dozen isolated plants that have been scrapped in favour of power supply from the company, the advantages of electric arc lamps over gas (which would be good reading for the City Fathers of London at present); a copy of a monthly journal called *Edison Light*, published by the company, is given to every visitor, and a postal list is compiled in order to keep in touch with prospective customers.

The apparatus exhibited is most varied, ranging from automatic flash signs for advertisements, electric foot-warmers, and including such items as ovens, fans, curling irons, tea kettles, sterilizers, theatre dimmers, shades and brackets, besides the more technical display of meters, wall boxes, switchboards, and such like. Adjacent to the show-rooms is the office of the publicity department manager, enabling him to pounce upon a waverer at the crucial moment, and to note the effect on the public of each of his efforts. Moreover, there is an automobile charging depôt here, forming one of the series of charging stations which the Boston Edison Co. has been largely concerned in establishing in the entire suburban territory surrounding Boston.

Turning to another American concern—the Denver Gas and Electricity Co.—we see again how "pushful" methods of advertising tend to increase business. This company has established a comfortable waiting-room at its main office where apparatus can be inspected and pamphlets on popular applications of electricity are distributed. Moreover, there is a public lecture hall attached, where demonstrations are given by efficient lecturers on the salient points of electrical engineering. The company does not wait for its customers to come to it; it posts them circulars and cards, keeping them well informed of the way in which advantage may be taken of electricity. For example, one card dealt with the advantage of numbered porch lights for dwelling houses, giving the cost per evening, and enlarging on the difficulty of finding the number of a house with unlighted porch in a dark street on a gloomy night. Only an American could exploit that!

The obstacles to the adoption of such methods in England appear to be two in number. British directors are often unwilling to spend money unless they see direct profits. The value of advertising cannot be definitely computed, and so long as the business of a supply company expands with comfortable steadiness, little effort is made to push sales.

The other objection is, that the average English professional man prefers to be dignified, even though he remain comparatively poor. One gentleman whose acquaintance with the business side of electricity supply was sufficient to make his opinion a criterion of the general sentiment of men in the profession briefly stigmatised to us the schemes for increasing business above described as "wild-cat." It may be that the temperament of the British public is not so susceptible to advertising enterprise as that of our trans-Atlantic cousins, but the experiment is, in our opinion, worth the trying.

Science Abstracts.

We have from time to time drawn the attention of our readers to the value of *Science Abstracts*, as a means of keeping in touch with the latest progress in all branches of science and engineering associated with the electrical and allied industries. A considerable interval of time, however, has elapsed since we last referred to the subject, and we may be excused for reverting to it with a gentle reminder.

Members of the Institution of Electrical Engineers and of the Physical Society, which jointly guarantee and subsidise this publication, probably need no reminder of its existence. Doubtless, very many of them are subscribers to it, not only for the sake of the information thus placed at their disposal, but also from a sense of duty as sponsors of *Science Abstracts*. Others, however, are not so well informed, and for their benefit we may point out that a vast amount of tedious research may frequently be saved by consulting its pages when investigating matters relating to questions of design, working and organisation. Special attention is also given by the editorial staff to the capital outlay and working costs of existing undertakings.

Science Abstracts is not, like many periodicals, of purely ephemeral interest; its value increases at an increasing rate as time goes on. Already its seven fat volumes form a substantial addition to the library, and constitute a complete record of progress during the corresponding years. We can, from personal experience, vouch for its worth, and cordially recommend it to our readers.

Post Office Polarised Sounder B.—This sounder, which was illustrated on p. 756 of our last issue as made at the Peel Works of the G.E. Co., has two sounding plates of different tones, between which the striker, actuated by the armature, plays. A stroke on the left-hand plate corresponds to a "dot," and a stroke on the right-hand plate to a "dash" in the ordinary Morse alphabet. The instrument has an advantage for beginners, as it can be read visually as well as by sound. The coils are wound to the very high resistance of 4,500 ω per pair, and in the base of the instrument there is a non-inductive shunt coil wound to a resistance of 27,000 ohms. It is so sensitive that it can generally be used direct on the line without the intervention of a relay. This instrument is also being used on a central battery telegraph system in London.

D

LAMBTON COLLIERIES POWER DISTRIBUTION SCHEME.

(*Concluded from page* 791.)

It is unnecessary to deal at length with all the other proposals in this precious document, as this would simply mean wearisome repetition. For example, in the Maudlin seam the motor is to answer all the same requirements as the foregoing, but at half the output; thus, instead of a "350-B.H.P. starting torque," the motor is to give 175. The "capacity" of the necessary transformer for this motor is specified as 10 K.V.A.!

In the Dorothea pit, the haulage motor is to exert a starting effort "corresponding to 150 B.H.P." It is to have a controller to give "a speed regulation from full to one-third speed with an 80-B.H.P. torque for 3 consecutive minutes every 10 minutes, as well as a speed regulation from full to half speed with a 20-B.H.P. torque for 3 minutes every 10 minutes, 5 minutes after the first speed regulation."

The above motor will be tested for "6 hours at 70 H.P., and every 10 minutes a 140-B.H.P. overload will be put on for 15 seconds." A second test of 3 hours' run at 90 B.H.P. will be taken, and every 10 minutes a 140-B.H.P. overload for 15 seconds will be put on. The temperature rise in the first test is not to exceed 70° F., in an atmosphere where the "ventilation is indifferent," and in the second test it is not to exceed 80° F.

The wording of the above might mean that the 140-B.H.P. overload was additional to the 70 and 90 B.H.P., but, judging from other portions of the specification, a 140-B.H.P. *load*, not *overload*, is meant.

The test for the controller is to be for 10 hours under the conditions specified or "equivalent," "by equivalent conditions it being understood that the value of—

$$\sqrt{\frac{1}{T}\int i^2\,dt}$$

will remain the same." Why not write "the R.M.S. value of the current?" The tests are to be made in the presence of the company's engineer, "who may act in the above matter to suit his own good judgement." We should hesitate very much to submit to such a clause as this.

Pump.—For the Maudlin seam a two-crank single-acting pump is required, to run at 50 r.p.m., and to deliver 70 gallons of water per minute at a head of 200 ft. This is to be worm-geared to a motor running at 1,000 r.p.m., and the efficiency, including both the worm gear and the pump, is to be at least 70 per cent. We hope that he may get this 70 per cent., but are very doubtful.

In connection with the pump are to be provided an hermetically enclosed switchbox "containing one gas-tight set of fuses, 10 amperes 500 volts for medium pressures." What "500 volts for medium pressures" means is quite beyond us.

Dorothea Mine Haulage.—The haulage gear is to be absolutely identical with the one specified for the Herrington Hutton seam. "Everything specified in one instance applies indiscriminately to the other." Indiscriminately!

The motor is to be identical with the Maudlin seam motor; nevertheless "the respective output and capacities of the motor and controller are to be 10 per cent. higher for the same temperature rise, &c.," but "the maximum torque remaining 200 B.H.P."

How the output can be 10 per cent. higher and the maximum B.H.P., torque, and speed, remain the same, is, at least, puzzling. The author is surely a little at sea as to the practical application of Ohm's law, as he says, "the amount of resistance, *i.e.*, number of ohms in the controller, is to remain the same. Its capacity is to be somewhat greater as the maximum output has increased." As the current is greater, the resistance should be less for the same voltage variation.

Another haulage motor is required which is to be of the Arnold two-speed type to give "namely, 250 and 125 revolutions at synchronism. This speed variation being obtained by commutating the poles in the stator." The starting torque "is to be equal to 450 B.H.P. Time taken to accelerate, 15 seconds every quarter of an hour."

The conditions for this motor are expressed in the same ambiguous way as the others, torque and horse-power being freely mixed up.

It will be noticed that the speed given corresponds to 48 stator poles. The maximum rope speed is 12 ft. per second, which is to be brought down to 8 ft. "if possible and practicable" by commutating the poles of the motor. This obviously involves altering the stator poles to 32.

A similar motor is to develop 165 B.H.P. for six hours, and 250 B.H.P. "during 60 seconds without inconvenience"; and is further "to develop a starting torque equal to 400 B.H.P. every 60 seconds twice in succession if necessary." The motor is not to fall out of step whilst developing any output up to 350 B.H.P. with but 90 per cent. of the full voltage. Here again we have the extraordinary condition that a motor is to be started up "with 400 B.H.P. torque twice in succession" (30 seconds interval); the time taken to accelerate being 15 seconds. This is to take place every seven minutes.

High Lift Turbine Pump.—In the D. and Lady Ann pit two high lift turbine pumps are required, each to deal with 700 gallons of water per minute against a theoretical head of 580 ft. The motors are to be run at 500 volts and to be enclosed, damp and gas proof. After having stood idle for a period of two weeks in a saturated atmosphere, temperature 70° F., the motor is to stand 2,000 volts alternating without any fear of the insulation breaking down. With each motor is to be provided "a metallic starting resistance of oil-cooled type with hermetic contacts" whatever this may mean.

An ohmmeter is to be provided to test the insulation of the motors whether at work or standing. It is not specified whether the 500-volt alternating current is to be used on the ohmmeter or what, but the ohmmeter stands a very good chance of getting burnt out; nor is it obvious how the insulation resistance of the motor can be determined when it is connected up to a circuit of which the insulation resistance may not be known accurately. Surely any test of this sort would give the joint insulation resistance of line, transformer and everything else connected with the metallic circuit. The efficiency which these pumps will have at the end of 12 months is to be stated and guaranteed. This is to be tested on site by means of an accurately-gauged manometer, the water being measured at the discharge.

The efficiency of the pump and motor will be arrived at by "an elementary calculation." No calculus required this time!

It is to be noted that the output of water is to be measured at the discharge, presumably at the end of the pipe line; the efficiency of the motor and pump therefore is handicapped by any leaks at the pipe joints. Yet for every 2 per cent. that the efficiency is found below the guarant e figure "£200 will be knocked off the price for each pump."

Express pumps are to be quoted as an alternative, each fitted with belt pulley 10 ft. in diameter and of sufficient inertia to ensure a regularity of $\frac{1}{75}$ per revolution defined by $\frac{1}{2}\left(\frac{\text{v max} - \text{v min.}}{\text{v max.} + \text{v min.}}\right)$. The pumps are to be of German make, namely, "either of the Ehrhardt & Sehmer, Bergmanns, or Klein Schanzlin types." No English maker need apply.

Philadelphia Works.—Several motors are wanted here for the workshops, and do not call for much special comment. There is one rather curious feature, however, in connection with the punching machine motor. This is to be a 5-H.P. motor running at 750 r.p.m., provided with a starting resistance, the last contact of which "is to be left permanently in circuit and to produce 10 per cent. slip at full load. . . . A squirrel-cage motor is not suitable here." As there are dozens of punching machines being driven by squirrel-cage motors, the meaning of the specification is not obvious. Perhaps, however, it is safe to put this down to the inexperience of the author with this class of work.

We think we have now abstracted sufficient of this unique specification to enable our readers to form some idea as to its general trend. It is quite obvious that whoever drew it up has had very little practical acquaintance with electrical transmission of power in collieries, and he appears to have a very hazy notion as to the meaning of technical terms. The only indications as to the authorship are the initials which

appear on some diagrams which accompany the specification, but we should scarcely think that the gentleman we have in mind, whose initials correspond with these, would perpetrate such a document, though the fact of Arnold La Tour motors and German pumps being specified would appear to point to this. We should imagine that very few English manufacturers will be found to tender to the specification without considerable modification of its terms, and it seems a pity that so important a power scheme as that of the Lambton Collieries should have been handled in the inadequate and slipshod manner demonstrated by our quotations. The specification might with advantage have been written in intelligible language, and British manufacturers ought certainly to have had at least an equal chance with foreigners.

AN ELECTRICAL REVIEW OF THE LOUISIANA PURCHASE EXPOSITION OF 1904.

By R. BORLASE MATTHEWS, Wh. Ex., A.M.I.C.E.

(*Concluded from page* 677.)

The general appearance of the Tirrill automatic voltage regulator is indicated in fig. 10, and a diagram of the connections for an A.C. circuit is given in fig. 11. The rheostat shunt circuit is opened and closed by a differentially wound relay. The current for operating this relay is taken from the exciter bus-bars, and is controlled by the floating main contacts. The current for operating the direct current control magnet is also taken from the exciter bus-bars. The alternating current portion of the regulator consists of a magnet having a potential winding which is connected, by means of a potential transformer, to

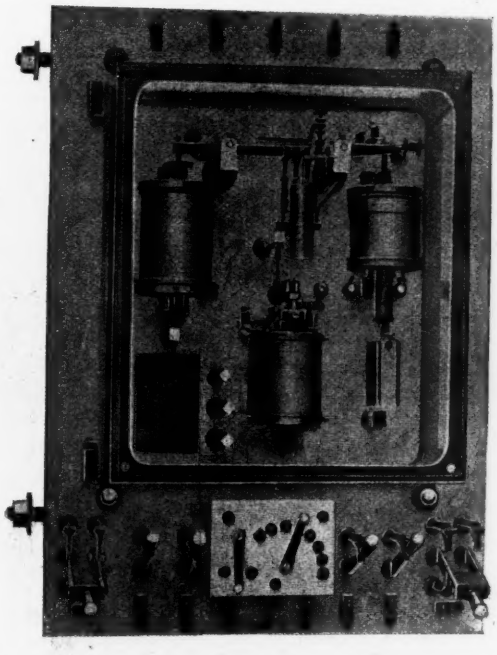


Fig. 10.

the bus-bars or the circuit to be regulated, and it also has an adjustable compensating winding which is connected in series with the secondary of a current transformer inserted in the main circuit. The core of this magnet is attached to a pivoted lever carrying a counterweight, which is balanced by the attraction of the magnet. If a load is thrown on the generator the voltage will tend to fall, the alternating current magnet will weaken and destroy the balance of the core and lever, and cause the main contacts to close; this in turn will close the relay contacts and entirely short-circuit the exciter field rheostat, thus increasing the exciter voltage until the original balance of the alternating-current magnet core and lever is restored, and the alternating-current voltage maintained at the required value.

A feature which attracted the observer's attention on the generator which furnished exciting current for the 3,500 KW. unit exhibited by the Allis-Chalmers-Bullock Co., was a brush oscillating device. The brushes are carried in the usual ring rigging, and this sets in what at first glance appears to be the usual grooved bearing wheels. Closer

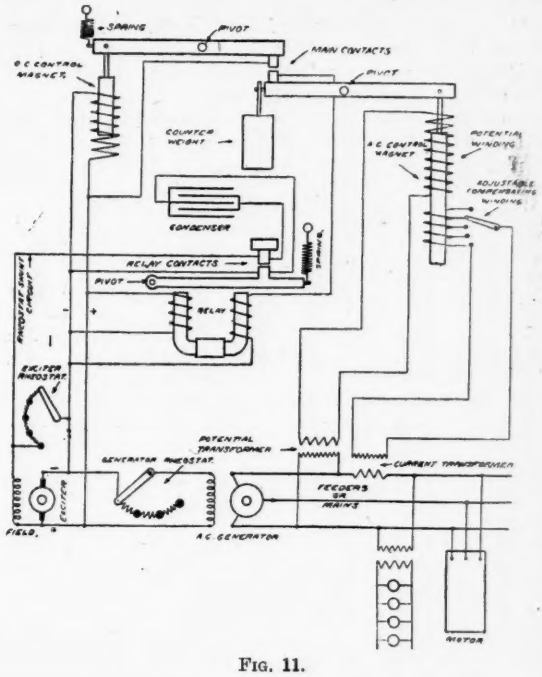


Fig. 11.

observation, however, reveals the fact that when the exciter is in operation, these wheels are slowly revolved through the medium of a belted gear and oscillating clutches, and as they make a revolution they are forced along their axles by a cam until they have moved about ½ in., when springs return the wheels to their former places. This process is continually

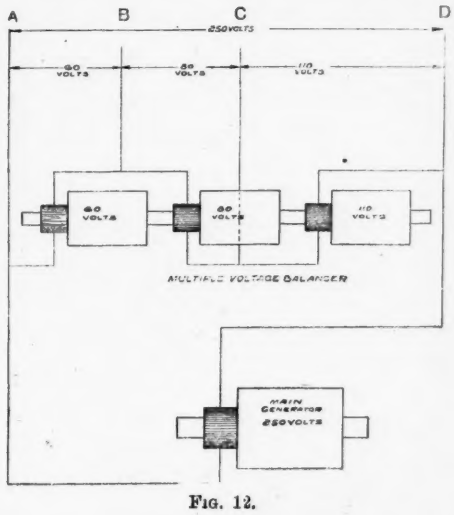


Fig. 12.

repeated as the generator runs, thus preventing the brushes from wearing grooves in the commutator, keeping both brushes and commutator smooth, and freeing them from dust and dirt. It has also been found that the oscillating action of the brushes will wear down and remove causes of trouble from any part of the commutator. This eliminates several ordinary causes of sparking.

A good deal of attention is being paid to the motor driving of machine tools. The motor manufacturers are evolving more compact machines than they did formerly, which are especially suitable for variable speed work. A special development in this direction

is the multivoltage control system, in which a multiple voltage balance is connected across the main circuit, as shown in the diagram, fig. 12, herewith. In this instance the armatures are in series across the 250-volt mains, the armatures being wound for 60, 80 and 110 volts respectively. Four leads are taken away to each machine motor, which can be connected across any pair, and accordingly run at a corresponding speed.

Owing to the large extent of the grounds, a railway known as the Intramural was built for the convenience of the visitors. The rolling stock and auxiliary apparatus used on this railway served as a working exhibit. The main motors on the cars were operated on the G.E.C. multiple unit system, which is now well known in England. The brake equipments were of the Christensen straight air type, which is largely used in the United States. Not only is the air brake used in America because it gives safe, durable and reliable braking, resulting in a very good and a complete control of the car to which it is fitted, and leaving the driver more alert at the end of his day's work, as he is not fatigued with the hard work of applying the hand brake, but also because it is more economical than a hand brake system, in many cases showing an economy of 10 to 15 per cent. At first thought it would not seem as if this would be the case, but upon carefully examining the practical operation, it will be seen that the economy of the air brake arises chiefly from the fact that the brake can be so quickly applied that the driver always leaves it in the off position except when actually required, so that the shoes are clear of the wheels; whereas with the hand brake, especially in crowded traffic, the driver usually keeps the brake blocks just riding on the wheels in order that he may have the car more completely under control, and thus avoid collisions. Also, in starting, the hand brake is very often not fully released. Thus the extra current which would in case of the hand brake system be required to overcome the friction of the brake blocks, is saved, and of course is found greater than the same amount of power required to drive the independent motor-driven air compressor.

The motor-driven air compressor used with the brake system is a very compact piece of apparatus, the motor being mounted directly above the compressor, and driving the latter through a pinion and gear. The general appearance of this machine is shown in fig. 13. The motor is series-wound, and specially designed for this work. It is started

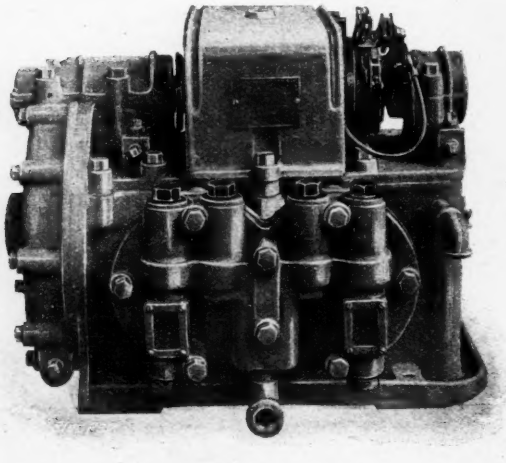


Fig. 13.

and stopped by an automatic governor when the pressure in the main reservoir falls below or rises above certain predetermined maximum and minimum pressures, without introducing any starting resistance into the circuit.

The National Electric Co., of Milwaukee, who are the makers of the Cristensen air brake, exhibited a multiple unit system for the operation of the air compressors. Such a system is essential if the multiple unit system of train control is adopted, for if it were not adopted for the compressors as well as the main motors, the compressor on each motor-car would have to be large enough to handle the longest train ever likely to be put together. Two systems are used for the multiple control of the compressor motors, one in which the standard automatic governor is used, and in which all the current required to drive all the compressors passes through a balance wire running the length of the train. As in many instances this is not advisable, a second system was devised in which a special automatic multiple unit governor is used in place of the ordinary governor. The connections of the governors are so arranged that each starts and stops the compressor on its own car, and at the same time all the governors on the train are so connected that any one of them starts and stops all the others, thereby indirectly starting and stopping all the compressors on the train. This latter system only necessitates one balance wire running through the train, which can be carried in the cable used for the leads from the master controller. The current passing through it will be very small, being only that required to energise the solenoids of the governors.

As illustrating the advance in high-tension practice, nothing could be more striking than the exhibit of a million-volt, 25-cycle, 100-KW. transformer, by the Purdue University School of Electrical Engineering. This

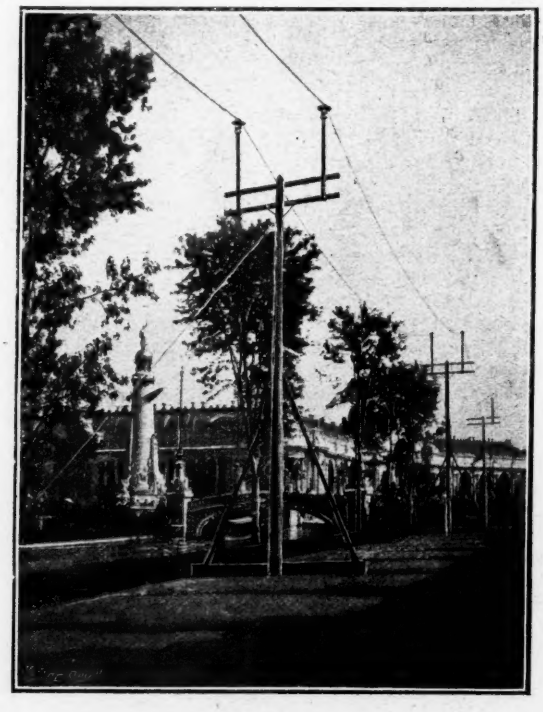


Fig 14

apparatus was shown in operation in the Exposition Grounds, late in the evenings, when the majority of the general public had departed and consequently the danger was reduced to a minimum. Unfortunately, the temporary building in which it was located was too small, and so a higher potential than 500,000 volts could not be obtained without discharges taking place on to the roof and tank bolts in the vicinity. Apparatus of an equally high or higher pressure has been built before, but never of such large capacity, and at such a low frequency. The discharges are of a similar character to those produced by commercial high-tension transformers. A double overhead line a few hundred feet in length was erected in conjunction with this exhibit (see fig. 14); the conductors were carried on triple petticoat insulators, some 14 in. across, which were made for a 60,000-volt transmission line. These insulators were supported on 6 ft. lengths of insulating fibre piping. In parallel with this line a spark gap was connected, composed of two inclined vertical rods 1 in. in diameter, placed on movable stands and insulated in the same manner as overhead lines. Brilliant discharges, accompanied by a sharp cracking report, took place when the rods were placed 2½ to 4 ft. apart.

High-tension insulators have been greatly improved. Both glass and porcelain insulators are used for potentials up to 25,000 volts; up to 15,000 volts, glass is generally preferred. The diameters for pressures at or below 10,000 volts are about 5 in.; 7 in. insulators are successfully used on voltages up to 25,000, and a 13-in. insulator is sufficient up to 40,000, while at 60,000 it is considered that a diameter not less than 14 in. should be adopted. Even larger sizes would be utilised if reliable insulators could be manufactured. Iron pins are now coming into general use for the support of the larger insulators.

Pending the completion of the new buildings of the National Bureau of Standards at Washington, the apparatus intended for use there was exhibited at the Exposition, and used by the International Jury of Awards for the Department of Electricity in ascertaining the merits of the apparatus and instruments submitted by the exhibitors. In this way facilities were at the jury's command which are not usually available in connection with such expositions, and consequently the exhibitors were better pleased, as they knew the awards were based upon an exact investigation.

A little dissatisfaction was expressed at so many of the awards going abroad, and also at some of the rules upon which the awards were based; but, on the other hand, it is admitted that the juries acquitted themselves of their difficult task very creditably.

A very important work carried out during the Exposition was that done by the Electric Railway Test Commission, appointed by the President of the Exposition. A great deal of valuable testing was done by this Commission under the supervision of trained men, with a view of solving some of the more important of the undetermined problems connected with electric railway work. A great deal of interest was taken in these tests, which were very carefully and energetically carried out, and when the records are published, they will form an authoritative statement which will be of great value.

As a feature which will for a long time keep alive the association of the St. Louis Exposition, the International Electrical Congress of 1904 is foremost. A large amount of work was accomplished in a very concise and satisfactory manner, resulting in the collection of much information of great value and high quality, which will greatly assist in the future development of electrical engineering. The resolutions of the Chamber of Official Delegates, whose meeting coincided with that of the Congress, though seemingly disappointing in that no definite decisions were arrived at, have undoubtedly by their suggestions to the various governments made the way clearer for a closer international agreement in electrical matters in the future.

INSTITUTION OF ELECTRICAL ENGINEERS.

USE OF ELECTRICAL ENERGY IN MINES AND COLLIERIES.

By M. B. Mountain, M.I.E.E.

(*Abstract of Paper read on March 28th, 1905, at Manchester.*)

The Parliamentary inquiry, for which the Special Departmental Committee commenced its sittings at the end of 1902, has done a very great deal in this country to clear away the prejudice which, to a certain extent, existed against the use of electricity.

One of the chief recommendations of the Committee is that good work should be insisted upon in every case. It is, perhaps, not too much to say that in the past more harm or injury to the electrical industry, as applied to mines, has been done by the work being of an "indifferent" nature than from any other cause. No other source of power lends itself so fittingly as electricity to the needs of a mine. The cables do not cause any inconvenience, the running and fixing of them is simple, and the loss in conveying the current representing the power is very much less than by either of the old methods. Savings varying from 20 per cent. to 80 per cent., or even greater, have been made in cost of working, but actual or accurate figures are somewhat difficult to obtain. Electric haulage has doubled the output of the mines of one company, and, at the same time, has reduced the cost of traction from 4d. to ½d. per ton, and effected a total yearly saving equivalent to 30 per cent. on the outlay on the electrical plant, so that the latter paid for itself in a little over three years. In an American mine, where mule haulage was used, the substitution of electric locomotives reduced the cost of traction from 5d. to less than ½d per ton, and effected an annual saving equal to 90 per cent. of the cost of the electrical installation. Such examples might be multiplied indefinitely. There are numerous economies which are less easily reduced to definite figures than the fuel and labour items, but which are, nevertheless, of great importance in a comparison of electric with other forms of power transmission.

As in all electrical installations for mines and collieries, we have to consider the system to be employed and the machinery and appliances necessary to do the required work.

It can, perhaps, be said that direct current is the most serviceable for small installations, and where the current has not to be conveyed to any very great distance, and that alternating current, preferably three-phase, should be used where the installation is on a large scale, and it is required to convey the current to a considerable distance. Good work has been done by both systems. As motors can be, and are, constructed with cases entirely enclosed, and work satisfactorily, assuming, of course, they are properly rated, so as not to become too hot in working, there seems to be no reason for considering direct current as dangerous. It is not customary to construct direct current machinery for a higher E.M.F. than 500 to 600 volts, so that, to a certain extent, this limits the use of direct current for long distances owing to the losses in conducting cables.

A three-phase system permits of generating and conveying current to a long distance at a high voltage, by which means the cost of conductors is very materially reduced. By the use of transformers the voltage can be reduced to any required limit, or it can be converted into direct current for any special requirements. Three-phase motors can be used with every satisfaction upon all work where the load is constant and the speed constant, as in the case of certain classes of pumping, &c., but for variable speed the conditions are rather difficult. A three-phase system cannot easily be used for power combined with lighting, as the frequency most applicable for power is not suitable for lighting; for traction also three-phase presents difficulties. Taking all these points into consideration, a combination of direct and alternating current systems would seem to be the most advantageous.

Possibly there is more chance of accident to the men employed through the use of inferior cables than by inefficient machinery. The cables now being made for use in mines are very greatly superior to what they were a few years ago. Armouring of steel tape or wire has been found more satisfactory than lead-covered cable, and the galvanised wire seems to be preferred to the steel tape, as it allows of greater flexibility, and for shaft cables takes the weight of the cable in a better manner. Concentric cables have been much used in mines, but for continuous-current work two single cables are better. It is important that the cables in all cases should have a thoroughly substantial insulation, suitable for the working conditions, and the sectional area of the cables should be well above the maximum requirements. Perhaps the best method for fixing shaft cables is a continuous grooved casing with cover from top to bottom, in which the cables are tight fitting.

It is desirable as far as is permitted by the new rules, to *earth* the cables, or the armouring of them.

For the electric lighting installation in a mine the use of tubular conduits for cables and damp-proof fixings and fittings is most desirable, and is being carried out at present in all well arranged systems.

Experience has shown the great desirability in all instances of having motors amply large for the work to be done. There is possibly no place in which machinery is so subject to undue strain or overloading as in a mine.

Perhaps the most important application for which electricity should be employed is that of *main winding*. In this country there are comparatively few instances; it seems to have been left to our Continental friends to take the initiative. They have some very fine examples at work, amongst which the most important plants are those at Preussen II. Colliery, near Dortmund, Germany, and Grand Hornu Colliery, Belgium, both by the Allgemeine Elektricitäts Gesellschaft, and Zollern II. Colliery, Merklinde, Germany; the electrical machinery by Messrs. Siemens & Halske, Berlin.

The electrical winding engine has now been satisfactorily at work for more than 18 months at Pit No. 2 of the Harpener Mining Co. at Dortmund. It is designed for winding 100 tons of coal per hour from a depth of 765 yards.

The controller is operated by a single lever, which is moved forward or backward to correspond with the direction of the winding drum, the distance to which it is moved in either direction controlling the speed at which the drum works. The controller proper is of a patent liquid-resistance type.

The central station in which the whole of the energy for the Preussen Mine is generated, is not far from the winding engine, and contains three steam-driven generators of 800 H.P. each, with the very economical steam consumption of 12·5 lb. per indicated horse-power-hour.

It has been found that the amount of steam per pit horse-power-hour in lifted coal is 33 lb., a figure which is a strong advocate for this system.

Grand Hornu Colliery, Belgium.—The power house contains two direct-connected, steam-driven three-phase generators, respectively of 2,000 K.V.A. and 4,000 K.V.A. at 1,100 volts, and with a frequency of 23·5 periods per second.

In each of the Shafts VII. and XII. the coal lifted per hour is 65 tons from a depth of 3,300 ft.

The winding cycle (for coal) is as follows:—

Starting	15 secs.
Normal full speed	78 „
Slowing	12 „
Changing	39 „
	144 secs.

Horse-power up to 935 H.P. at start, 475—530 H.P. during running.

From Shaft IX. the coal lifted per hour is 56 tons, depth 1,864 ft.

Other services in these mines, such as pumping, ventilating, coal screening, &c., are also worked electrically, and absorb about 1,000 H.P.

Zollern II. Colliery.—The generating plant consists of three triple-expansion horizontal engines, each driving a continuous current generator, producing 1,100 KW. at 525 volts. The electrical winding engine at present is winding from a depth of 984 ft., but it is intended eventually to work to a depth of 3,600 ft. The engine raises about 40 loads per hour, each load comprising approximately 15 tons.

The output of coal raised is about 3,200 tons per day.

The winding engine receives its energy through a motor-generator built on the Ilgner principle, by which the energy stored in a revolving fly-wheel provides the starting effort to accelerate the cage winding engine.

In this country the Powell Duffryn Coal Co. have laid down an extensive electrical plant, and are winding by electricity, though on a smaller scale; about 320 H.P. is employed for this purpose. Messrs. Bolckow, Vaughan & Co. have also adopted electrical winding on a small scale, about 170 H.P. Both of these installations have been carried out by the Electrical Co., Ltd. (the English representatives of the A.E.G.).

Messrs. Ernest Scott & Mountain, of Newcastle-on-Tyne, have fitted up several winding gears in this country, though none of them can compare in size with any of the larger gears erected in Germany.

At the Heckmondwike Colliery a large fault or throw occurs about 3,000 ft. away from the pit-bottom. This fault throws down the coal-seam a vertical depth of 180 ft. below its original level. To win the coal-field on the dip-side of the fault it was necessary to drive either a large drift or sink a staple. If it had been decided to drive a drift, it would have been necessary to put down a powerful haulage plant at least equal to the size of the present winding plant. The driving of such a drift with a gradient of 1 in 6 would have involved 1,080 ft. of drifting, and the cost would have been about £1,960. The sinking of the staple cost about £3 10s. per ft. for 180 ft., or a net saving of £1,360 against the drift scheme. It also took nine months less time to win the coal by the staple than it would have done by the drift.

The shaft is 180 ft. deep, and, with the present arrangements, the winding gear is capable of raising from 150 to 200 tons per day of 10 hours. The winding drum is 3 ft. in diameter, and a wind is made in 40 to 45 seconds, equal to a speed of, say, 300 ft. per minute. The electric motor driving the drum is of the series-wound continuous-current type capable of working up to 40 effective H.P. when running at a speed of 500 r.p.m. A powerful foot-brake is provided for the drum, operated by a foot lever. As a further protection, this gear is fitted with an electric brake, which comes into operation as soon as the current is switched off, and thereby sustains the load. An indicator is also fitted on the winding gear to show the position of the cage in the shaft. This winder is operated by means of a liquid controlling switch arranged for reversing and speed regulation.

The application next in importance is haulage in mines; there are quite a number of examples in this country, and of considerable capacity, some of which have been at work for several years.

We have a very large number of important electrically-driven pumping plants in this country.

Ram pumps are perhaps most in favour. The general design and construction has been very greatly improved during recent years. They have been made to deal with a head of water up to 1,800 ft., and there are cases in which this type of pump is in use working against even a greater pressure.

Several very convenient forms of portable pumps have been introduced, which for use at the working faces or near by have proved very advantageous.

Centrifugal pumps are also used very considerably. The quadruplex form of pump will easily work against a head of 250 ft., and one special advantage in this form of pump is that it can be coupled direct to the motor, dispensing with the necessity of intermediate gearing.

There are one or two good examples of ventilation on a large scale in this country, but the writer has not been able to get definite figures with regard to them. At the Pelton Colliery, Durham, a "Sirocco" fan, made by Messrs. Davidson & Co., has been installed to replace two steam-driven "Guibal" fans. The "Sirocco" fan is driven by motors, and absorbs from 150 to 160 B.H.P., removing approximately 250,000 cb. ft. of air per minute; previously the two "Guibal" fans in use removed something under 200,000 cb. ft. of air and absorbed about 180 B.H.P.

Coal-cutting by electricity is another of the more important applications.

The total output from a seam of coal worked by one of Messrs. Mavor & Coulson's coal-cutting machines in the 12 months of 1904, represents no less than 25,535 tons; no interruption to the regularity of cutting five nights per week was caused by the machine, and the repairs of the machine cost during 12 months under £1.

TABLE I.—SCHEDULE OF SOME OF THE MOST PROMINENT BRITISH INSTALLATIONS IN MINES.

Name of mine.	H.P. of primary or generating station.	System.	Voltage.	Contractor's name.
Bolckow, Vaughan & Co ...	1,300	3-phase	2,400	The A.E.G. and the Electrical Co., Ltd.
Powell Duffryn	5,500	„	3,000	
Silverwood	1,200	„	500	B. T.-H. Co.
Hamsterley	140	„	550	
Calow (Staveley Coal and Iron Co.)	800	„	440	
Bond's Main Do. do.	700	„	440	
Warsop Do. do.	800	„	440	
Ireland Do. do.	850	„	440	
Markham Do. do.	800	„	440	British Westinghouse E. and M. Co., Ltd.
Duddingston Shale Mines	800	„	3,300	
Oxcroft	1,000	„	440	
Oakbank	1,000	„	440	
Glapwell	650	„	440	
Stanton Iron Works ...	800	„	440	
Tredegar Coal and Iron Co.	600	„	440	
Wigan Coal and Iron Co.	910	„	440	
Broughton and Plas Power Coal Co.	1,030	D.C.	600	
Ocean Coal Co.	300	„	500	
South Durham Coal Co....	440	„	550	
Ashington Coal Co. ...	250	„	550	
Mickley Coal Co. ...	100	„	530	Ernest Scott and Mountain.
Weardale Steel, Coal and Coke Co.	700	„	550	
Pochin Colliery, Tredegar Co.	250	3-phase	500	
Ty Tryst and Bedwellty, Tredegar Co.	1,050	„	550	
Caroline Colliery, Benson and Sons	140	D.C.	500	

TABLE II.—SCHEDULE OF SOME OF THE MOST PROMINENT CONTINENTAL INSTALLATIONS IN MINES.

Name of mine.	H.P. of primary or generating station.	System.	Voltage.	Contractor's name.
Preussen II.	2,400	3-phase	2,000	The A.E.G. and the Electrical Co., Ltd.
Thyssen & Co., Bruchhausen	3,000	„	550	
Grand Hornu, Belgium ...	6,500	„	1,200	
Saar-u-Moselbergwerksges, Karlingen	3,000	„	5,000	
Concordia Grube, Donnersmarkhütte Kattowitz (extension plant) ...	1,000	„	1,000	
Victor Rauxel in Westphalia	1,250	„	5,000	
Selbecker Bergwerksverein	1,650	„	2,000	
Gewerkschaft Graf Moltke	2,000	„	...	
Gewerkschaft Consolidation	4,000	„	...	
Eschweiler Bergwerksverein, Rheinland ...	3,700	„	...	
Braunkohlengrube Marie Louise, Oschersleben ...	1,000	„	3,300	
Colonia Langendreer ...	2,700	„	3,000	
Engelsburg	1,200	„	2,150	
Maria Anna and Steinbank	1,000	„	2,000	
Centrum	1,500	„	2,400	
Hamburg and Franziska Mines	1,995	„	2,000	
Wirn Minese	2,400	„	2,000	
Rheinpreussen Mines ...	1,000	„	2,000	
Zollverein Mines, near Caternberg, Essen	795	„	500 and 1,000	
Georg Marien Osnabruck Mines	2,444	„	2,000	Messrs. Lahmeyer and Co.
Charlotte Collieries, Czernitz	706	„	800	
Lena Gold Mining Co., St. Petersburg... ...	740	„	150, 260 and 10,000	
Schnabel ins Osten ...	2,250	„	1,000	
Comp. des Mines, Ligny les Aires	500	Continuous current.	500/550	

Rock and coal drilling by electricity is also in use, although to a certain extent it still has a keen competitor in compressed air, but

it can be said that the electrical drill is considerably more convenient as well as being more economical.

Electric traction has not been made as much use of in connection with mining in this country as might have been expected. This may be due to the necessity for using uninsulated conductors forming the trolley wires, against which there has been considerable prejudice, but by the investigations of the recent Parliamentary Committee and their recommendations, the probabilities are that electric traction below ground will come into much greater use. In America and in some foreign mines it is largely employed; this is possibly owing to the fact that in many cases there are no pit shafts, the main roads being drifts made in the side of hills, and therefore very convenient for the entrance of trains.

For electric traction, continuous current has been most generally used; there are difficulties in the way of working with a three-phase system, and up to the present single-phase machinery, although very suitable for traction work, can hardly be said to be sufficiently introduced to warrant mining engineers adopting it.

In a great measure this paper has been written with special reference to work in this country, but it must not be supposed that in our Colonies and other foreign countries, apart from the Continent, it has been overlooked. In South Africa there is possibly one of the finest electrical installations to be found in the world, *i.e.*, at the De Beers and Kimberley mines. The De Beers mines are almost entirely worked electrically, and their installation is being continually extended. In 1903 the generating station at these mines contained plant giving an output of 4,000 H.P.; the current being generated at 5,000 volts and distributed throughout the mines upon a thoroughly up-to-date system. Apart from the various machinery in and about the mine, locomotives were employed for hauling the trains of trucks, and the whole installation can be considered to be of a very model type. There are other mines in South America and in Australia which are equally up-to-date.

The writer has prepared some tables giving the names and outline particulars of the more prominent installations on the Continent and in this country, and hopes that the figures and particulars will prove of interest.

Discussion.

Mr. A. H. Gibbings hoped the author would follow up the paper with another one giving more details. Some time ago he went down one of the deepest mines in Austria, and saw a motor driving a set of three-throw ram pumps, which had been running several years with satisfactory results, and on which they had never experienced a breakdown.

Mr. Preece thought the present generation of mining engineers would need a good deal of educating up to electrical work. Most of the failures were due to bad supervision, and a skilled man ought to be employed. At a meeting held in Manchester, it was agreed that a high pressure supply was safer than low pressure, on account of the employés thinking that if they touched a high pressure wire it would lead to fatal results, whereas they might touch a low pressure wire and escape with a shock. He considered that where men were always in a state of perspiration, any voltage would probably be fatal. He thought the tendency now was to use bitumen cables, especially for low-pressure work. They were lighter and more easily handled, but for pressures above 500 volts he did not think them suitable. Lead-covered cables were used in some mines, but he did not think them advisable on account of the weight and the danger of mechanical injury to the lead sheathing, which would allow of dampness getting to the dielectric. It was possible that a cable with paper dielectric and a covering of bitumen would be suitable. Rubber cable was nearly always used on coal-cutters on account of its flexibility, but it should be covered with a braiding of leather. Some colliery managers liked to have their cables hanging in the shaft, but this caused a great strain on them, and for this reason cleats were employed at intervals down the side of the shaft to support them.

Mr. Willis remarked that one had to see a plant at work to fully appreciate the tremendous difficulties of this class of work. On the question of three-phase A.C. or D.C. supply for hauling gear, he thought D.C. was more suitable on account of frequent stopping and starting. Centrifugal pumps were better and far simpler than reciprocating pumps; there were many running at 600 ft. head.

Mr. Cooper said that some time back he had fixed two 50-H.P. motors on a hauling gear in a colliery, which had run very satisfactorily. The cables were run down the shaft in duplicate, and supported by cleats. Open liquid starters would not do for a fiery pit.

Mr. Cormack said that several very successful winding gears had been put in on the Continent. Difficulty was experienced in getting manufacturers to guarantee the efficiency of high lift centrifugal pumps for a period of years.

Mr. Mountain said there was an increasing desire on the part of colliery proprietors to take up the question of electrical driving, and he hoped that before long figures would be available as to power costs, &c. The object of driving by electricity was economy. He thought that bitumen cable was very good, and was easily laid in the ground. Heavy strains were frequent on underground work, and they could not allow too much margin for future work. On the relative merits of centrifugal and ram pumps a great deal might have been said. Manufacturers did not give guarantees as to centrifugal pumps with the same readiness as with ram pumps. Another thing in favour of ram pumps was that they could be easily taken apart, which was an advantage in taking them down a pit.

A vote of thanks to the author brought the meeting to a close.

LEGAL.

The Mayor, Aldermen and Burgesses of the Borough of Swansea v. The National Telephone Co., Ltd.

In the Chancery Division of the High Court of Justice, on Thursday, May 11th, Mr. Justice Buckley delivered his reserved judgement in this case in favour of the Corporation. He said he was told this was the first case in which application had been made to the Court to construe or enforce the Telegraph Act of 1899 with reference to intercommunication between competing telephonic systems within the same area. As the matter was one of considerable public importance, he reserved his judgement with a view of expressing as clearly as he was able the view he took of the Act, and the remedy available for its enforcement. The question in this action arose under Sub-sec. 5 of Sec. 3, which was a sub-section in favour of the new licensee. That provided that: "If the licence of an existing company is, under the provisions of this section, extended in respect of any exchange area for a period of not less than eight years beyond the time existing at the passing of this Act, the company shall, at the request of any other licensee of the Postmaster-General providing public telephonic communication in the whole or any part of that exchange area, and under such circumstances and on such terms and conditions as may within six months from the passing of this Act be prescribed by an order of the Postmaster-General, made with the approval of the Treasury, afford all proper facilities for the transmission of telephonic messages between persons using the system of the company (either in the whole or in part of the exchange area as the Postmaster-General may prescribe) and persons using the system of such other licensee, provided that the licensee so requiring intercommunication shall in any such case afford similar facilities." It was obvious that if the right of intercommunication arose, many questions might present themselves as to the terms which might be fair as between the existing company and the new licensee. He might instance the following: First the question as to how the expense of connecting the two systems should be borne between the two companies; secondly, the question who was to do the work of making the connection; and thirdly, whether, as between the two companies, the one ought to make to the other any and what payment for the advantages arising from the communication to their respective customers. The one undertaking might be of extensive mileage, with a large number of exchanges, and the other might be of very small dimensions. It was not evident that intercommunication would in justice be given, without providing for a payment to be made by the one to the other. As to all these and other like matters, the Act was silent. If they were provided for, it must be by the order of the Postmaster-General. The defendants argued that the Postmaster-General might have determined what were proper facilities, and that he ought to have done so, and further that inasmuch as he had not done so, the Court had no authority to determine what were proper facilities, and that the parties must agree amongst themselves as to what they were, and failing agreement, the Act broke down. He did not accede to that argument, nor any part of it. The Postmaster-General could by his order determine the circumstances under which, and the conditions upon which, proper facilities should be afforded. But the Act did not remit it to him to say what the proper facilities were, and the statutory right could not be a right to that which the parties agreed. That was equivalent to saying there was no statutory right, for either party could in that case defeat the statute by refusing to agree. Within six months the Postmaster-General did make the order within the Act of Parliament. Its effect for any purposes relevant to the matter before him was that by Article 1 it was provided that the new licensee must have a certain number of subscribers before he could demand intercommunication. The article provided for certain terminal charges which might be made by the old and the new licensee respectively, and by Article 5 the new licensee who requested facilities should satisfy the Postmaster-General that he had complied with Article 1. The order did not deal with any of the questions which required determination as between the two undertakings. The proper facilities mentioned in Sub-sec. 5 were facilities for the transmission of telephonic messages between the customers using the one system and the customers using the other, and those, he thought, must be proper facilities for using all the several component parts of the system, as were in a proper course of business appropriate for the transmission of the message. If intercommunication were established, then the customer of company A was to be given proper facilities for using all those parts of the system of company B which were appropriate for the purpose of communicating telephonically with a customer of company B. Passing to the facts of the present case, his Lordship said the relevant facts were that the defendants had, before September, 1902, established a system of public telephonic communication in the Swansea area, and that in September, 1902, the Postmaster-General granted a new licence to the plaintiffs over the same area. At the same time the Postmaster-General granted the defendants an extension of their then existing licence for a period such as to call Sec. 3 Sub.-sec. 5 into operation. In November, 1903, the plaintiffs had established and then opened their system. On January 4th, 1904, they made a request for intercommunication. They had at that time the number of subscribers required to satisfy Article 1 of the Order of the Postmaster-General. Before February 2nd, 1904, they had within Article 5 of the Postmaster-General's Order satisfied him as to that

fact, and the defendants were informed by the Postmaster-General he was so satisfied. That the Corporation had the requisite number of subscribers was not now in dispute. The defendants raised various contentions. He was satisfied, as Mr. Gaine said in the box, that the defendants desired to raise every objection which could be legitimately put forward to prevent the plaintiffs obtaining the communication they had a right to request and requested under the Act. The defendants had received the benefit of the extension of their licence, but intended to put every obstacle—they said legitimate obstacle—in the way to prevent the resulting benefit to the new licensee of obtaining intercommunication. With one exception these objections were not relied on now. The remaining contention was that upon which arose the whole question he had to decide. That contention was as follows:—The defendants had a central exchange at Swansea, and 11 or 12 subsidiary exchanges. After some variations from time to time, the defendants required that the plaintiffs should provide junction circuits to directly connect the plaintiffs' exchange at Swansea with the defendants' exchange at Swansea, and with each of nine of the defendants' subsidiary exchanges in different parts of the area, and junction circuits to connect the two Mumbles and Morriston exchanges. The defendants said there must be duplicate junction or trunk lines from Swansea, that was from the plaintiffs' exchange, to each of the same subsidiary exchanges; in other words, that every line running from Swansea to a subsidiary exchange must be duplicated by running another junction or trunk line from Swansea to the same point. He failed to find any justification in the Act of Parliament or founded upon reason or good sense for that contention; on the contrary, it seemed to him to be directly in contravention of that which the Act of 1899 intended to secure. The object was not to duplicate the systems so that each of the two undertakings should have junctions or trunk lines running all over the exchange in that area, but that the customers of each company should use the trunk line of the other company running to the customer of the other company whom he wished to address. The defendants' contention was extravagant and directly in destruction of that which the Act intended to give. But further, the defendants said their junctions or trunk lines were now fully occupied; but that was only so in the busiest hours of the day. The defendants were bound to give every intending customer within the area intercommunication on proper terms. Their undertaking was one which, from its nature, required extension by increase in the trunk line as traffic developed. The Act nowhere contemplated that the new licensee should, to the extent of any deficiency in the system of the existing company to meet the new traffic, increase for the existing company the capacity of the system of the existing company. Moreover, the defendants' lines were not congested in the sense that they could not bear a heavier load at time other than the busiest hours of the day. 85 per cent. of the plaintiffs' traffic was in Swansea, and the junction between the two Swansea exchanges would at once give the means of dealing with these without raising any question of traffic lines being congested. In the events which had happened, the defendants' customers were entitled as much as the plaintiffs' to the benefit of intercommunication. Every conversation which took place by way of intercommunication was a conversation to which a customer of the defendants was as necessarily a part and of which he had the benefit. The defendants refused to connect, and the writ was issued. The question for determination was whether the defendants had refused to afford proper facilities; in his opinion, they had. He did not propose to order the defendants to give facilities in any definite or exhaustive form, but he would indicate what he thought at least ought to be done; and if they did not do that, with or without some such modification as the nature of their business required, he should have the means of enforcing the order. The details must be left to those who had the conduct of the undertaking. The question between the parties was not whether intercommunication ought to be given, but how it should be given. The order he proposed to make would not involve that the Court should intervene to enforce the continuous doing of a succession of acts. The order would enforce the establishment of intercommunication. The Court might safely leave it to the Postmaster-General to ensure that the obligations of the service would be observed after the intercommunication had been established. The judgement he pronounced was as follows:—He declared that under Sec. 3 Sub.-sec. 5 of the Telegraph Act, 1899, and the order, and in the events that had happened the plaintiffs were entitled to be afforded by the defendants all proper facilities for restricted intercommunication within the order between persons using the defendants' system and persons using the plaintiffs' system; and he declared the defendants had improperly refused to give such proper facilities. There would be an order that the defendants do give such proper facilities, and there would be liberty to apply. The defendants must pay the costs of the action. Under the liberty reserved either party could apply to the Court, and if the defendants were really under any difficulty as to the connections they ought to make, or the facilities they ought to give, they could refer to the Court and not leave the matter to be determined by a motion for sequestration. As at present advised, he thought the junction circuits at the three places he had mentioned (Swansea, Mumbles and Morriston), and facilities for using them would be, for the present at any rate, a compliance with the order, and experience would best show whether anything and what further was required.

Mr. Astbury said that after the very careful and detailed judgement, the defendants would like to have the opportunity of carefully considering it in order to see how they could carry it out if they were so advised, and also of considering whether they would take the matter further. He asked his Lordship to give defendants a few days' time in which to consider the judgement.

Mr. Buckmaster said that his learned friend's application was not unreasonable in the circumstances.

After some further discussion, it was arranged that there should be a stay of execution for 14 days.

Wandsworth Borough Council *v.* London United Tramways Co.

Before Mr. Justice Warrington on 12th inst., Mr. Rowden, K.C., applied for directions and facilities for disposing of the action of the Mayor and Councillors of Wandsworth *v.* the London United Tramways, Ltd. There was a serious question on the construction of the London Tramways Acts as to their power to take up roads for the purposes of their tramways.

The hearing was fixed for Saturday, 20th inst.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Price Lists.

We have read with interest the article on price lists in a recent number of your publication, and the suggestions made in that article are well worthy of careful consideration by all the electrical and engineering manufacturers.

We have been working on a scheme which, we think, will lessen the cost of catalogues to manufacturers, and at the same time place them in a more convenient and permanent form in the hands of the largest buyers. Most lists are printed in a quarto size, and our scheme was to reproduce these photographically in a smaller size, say, 5½ in. × 4¼ in. This size would considerably lessen the cost, and still leave the type perfectly legible; and even if the original catalogue were not exactly quarto in size, it could be made to fit to the size given above. Our scheme was to bind each manufacturer's catalogue in a special volume with its own index. All the leading representative firms in the electrical and engineering trades would have their catalogues reproduced in this uniform size and style, and the whole series of volumes could be put in a hanging wooden bookshelf, and delivered to a selected list of large buyers. By this means buyers would have a library of catalogues permanently before them on their walls. They would be handy for reference and uniform in size, and if any manufacturer wished to issue a fresh volume, the new edition could be sent out without interfering with the other volumes already delivered to the buyers.

The scheme has not yet matured, but we should be glad to receive any suggestions for its working out.

Hazell, Watson & Viney, Ltd,
W. Howard Hazell, *Director.*

London, W.C.,
May 10th, 1905.

Boiler Rating.

The reply to the question of "Calories II." in your issue of May 12th is that no standard of boiler rating is generally adopted. The rating of water-tube boilers, for central station work, is found to vary anywhere between 3 lb. and 5 lb. of water evaporated per sq. ft. of heating surface per hour, the variation being accounted for by difference of conditions as to draught, quality of coal, ratio of grate area to heating surface, &c. As "Calories II." mentions, this question of "rating" has an important bearing on the stated price per KW. of a generating station; and, as regards working, a boiler worked continuously at the 5 lb. per sq. ft rate, which can be done under conditions ordinarily obtainable in practice, will require more frequent inspection and repair, and will have a shorter life, than if worked at the 3 lb. per sq. ft. rate. The most suitable rate of working will depend upon the local circumstances, but it is usually nearer the lesser figure.

W. N. Y. King.

Tramways Power Station, Sheffield,
May 13th, 1905.

Gas Engines and Storage Batteries.

This question, dealt with in your "Notes" of the current issue, opens a new field for enterprise in the future, and to it we must look for the solution of the electric lighting of small towns where the revenue and profits are small. Nearly all that has been written about producer gas plants only amounts to a repetition of the subject matter of makers' catalogues. Not a word is said about the difficulty of governing the engines at light loads, due to the richness of the gases, &c.

Some real information is badly wanted of the experience of the engineers who have been working such installations, preferably electric light central stations.

L. S. D.

New Regulations for Electricity in Mines.

With reference to the letter of "Idris" we beg to state that, since the publication of the Act, we have been making an earth registering instrument for use in coal mines, which we have been supplying to various collieries in the Midlands.

We shall be pleased to give particulars of the same to anyone in need of such an instrument.

The Walsall Electrical Co., Ltd.

Walsall, *May 16th*, 1905.

Lightning Conductors.

Some little while ago, in this town, I had the opportunity of examining damage done to a house which was unprotected. There was, however, a water service pipe to a cistern in the roof, which practically answered the purpose of a conductor; and it was particularly noticed at the time that only where there was a bend in the pipe had damage been done to the adjacent walls, in each case showing the discharge tended to keep going in a straight line. It is quite evident that had this pipe been straight throughout its length this damage would not have occurred.

This would bear out the results of experiments I made some 10 or 11 years ago with high frequency discharges.

Would it not be well, when fixing lightning conductors, to abstain, *in toto*, from bends, corners, &c., as a lightning conductor with them would tend to be of more danger to the house than service?

David Smith.

Tunbridge Wells, *May 17th*, 1905.

BRIGHTON MUNICIPAL TELEPHONES.

The Brighton Town Council having made an application for sanction to borrow a sum of £27,210, of which £11,617 was for telephone purposes, the Local Government Board appointed an inspector—Mr. H. Ross Hooper, M.A., M.Inst C.E.—to inquire into the matter. The inquiry took place in the Brighton Council Chamber on the 11th and 12th inst. The ratepayers took a great deal of interest in the inquiry, but judging from local press reports, the telephone section received the greatest amount of attention.

The Town Clerk, in supporting the application, gave statistics as to the area, the indebtedness, and the rateable value of the borough. Electricity loans amounted to £469,462, and telephones to £44,540 11s. 9d., with £4,666 sanctioned, but not borrowed.

The Inspector: That gives you a total of £49,000 sanctioned for telephones. Is that so?

The Town Clerk: The total loans sanctioned amount to £46,000, but there is in addition the cost of raising stock. He said it seemed only necessary for him to point out that in 1901 the Corporation obtained a licence from the Postmaster-General authorising them to carry on a telephone exchange business in Brighton and the adjoining district. The Corporation prepared a scheme for installing a 2,080-line exchange with 600 spare lines. This was submitted to the Local Government Board, and in two separate sanctions the authority was given to the Corporation to spend the sum of £46,666. Now, the capital expended up to March 31st last was £49,753 7s. 9d., including £2,867 19s. 9d. retention money on contracts, which had not yet been paid. Of this sum of £49,753 7s. 9d., the sum of £44,573 13s. 11d. had been spent on account of the sanction of £46,666, and £5,179 13s. 10d. had been spent in excess of the estimates upon which such sanctions were leased. Of course, this sum was spent without the authority of the Local Government Board. That was frankly admitted. The work was done as the emergency arose. The sanction of the Local Government Board ought, of course, to have been obtained, but the conditions under which the work was carried out did not admit of this being done, and the Corporation now applied for the permission of the Board to raise the loan for discharging that liability.

Replying to the inspector, Mr. Talbot said that the total excess expenditure, as already stated, was £5,179, and the amount of future expenditure which the Local Government Board was now asked to sanction was £6,365.

The Inspector: Of course you will have to put in evidence now that these works have not been commenced at all. Are they commenced or not?

The Town Clerk: They are commenced.

The Inspector: They are commenced? Therefore they cannot go under estimated expenditure.

The Town Clerk replied that they had been commenced since the end of the financial year, March 31st.

The Inspector observed that he would examine the engineer on the point.

Continuing, the Town Clerk said that there was still unspent on the loan of £46,666 already sanctioned a sum of £2,092 6s. 1d. This sum was required for the execution of those works in respect of which the loan was sanctioned. It was estimated by the manager that that sum would be sufficient to complete that part of the 2,080 line exchange which was at present unfinished.

The number of completed lines constructed was 1,725, and the number of "spares" constructed was 1,329, that was to say, 600 originally estimated for, and 729 additional, which had been provided in order to meet future requirements. The balance unexpended of the original loans, together with stock in hand, was ample to admit of the completion of the 2,080-line exchange.

Some of the works were to be carried out in the borough of Hove as in the case of some of the previous expenditure.

The Inspector: The original exchange for the scheme which was proposed to the Local Government Board was for 2,080 subscribers. The switchboard was built for that number under the present application.

The Town Clerk: There is further accommodation.

The Inspector: Yes, for extension, but it is equipped for 2,080 subscribers. It remains at that number to-day. There is no intention to increase the capacity of that switchboard under the present application.

The Town Clerk assented.

The Inspector: So that we have, therefore, the two loans originally sanctioned amounting to £46,666, and now the present application of £11,617, for 2,080 subscribers. For I take it that the switchboard cannot accommodate more than is arranged for. Whatever lines or extensions or spares you may have your actual number of subscribers cannot exceed the capacity of the switchboard. Is that the case or not?

Mr. Bennett: That is scarcely the case.—Pressed as to any additions to the original scheme which had been made, he said the only difference he could call to mind was the opening of a new switch room at Rottingdean and another at Portslade. That was the only material or important variation.

The Inspector: There is none at Rottingdean?

Mr. Bennett: No, that junction is not completed.

The Inspector: And for what number is the sub-exchange open in Portslade?

Mr. Bennett: The switch room is equipped for 50 lines and six junction lines.—Replying to further questions, he said the Brighton exchange was equipped for 2,088 subscribers and 48 junctions; Shoreham, 30 subscribers and six junctions; Steyning, 30 subscribers and six junctions; Hurstpierpoint, 30 subscribers and six junctions; Portslade, 50 subscribers and six junctions; Burgess Hill, 90 subscribers and six junctions. The exchange at Burgess Hill, he added, had proved so successful that the original switchboard had had to be increased, the original provision being for only 30 subscribers.

The Inspector: That was not, perhaps, in the original scheme at all. We'll have particulars of that afterwards. But the point, so far as I understand it, Mr. Bennett, is that the original scheme provided for 2,000 complete subscribers. The scheme as it stands to-day provides for 2,318 complete subscribers. Is that right or not?

Mr. Bennett: That is correct.

The Inspector: Very good. Then we have got to consider on the basis of 2,318 subscribers the expenditure to date and the amount which is now applied for. That makes it roughly a total of £62,000 for 2,300 subscribers, as against the original proposals of £45,000 for 2,000 subscribers.

Replying to further questions from the Inspector, Mr. Bennett said the spares provided amounted to 1,329, and they were going to add 312 spares in one direction and 312 in another, and a small cable of 120, to meet anticipated orders—that was, in certain directions. Mr. Bennett went on to explain that the provision of the original spares was dictated by other circumstances besides the necessity of meeting orders; it was mixed up with the question of wood paving.

The first witness for the Town Clerk was Mr. Verrall, a resident, who considered competition was essential for the protection of subscribers; he would rather subscribe to the two systems than go back to the conditions which prevailed when there was only one system in the borough, but as a ratepayer he held that there must be under no circumstances a charge upon the rates. This witness was asked by the inspector if he was aware of the number of towns in England which had their telephone systems, and supplied the answer, "They are four—Hull, Swansea, Portsmouth and Brighton." He asked further: Have you any experience of other towns which have not got municipal telephones, as to the efficiency of their telephone service? To which the witness replied: I am speaking entirely of Brighton, and of the enormous benefit we have had since competition began.

The opposition to the application was led by Mr. E. Elvy Robb, who asked this witness: Are you aware that in Tunbridge Wells since the sale of the telephone undertaking the rates have been reduced by 4d. in the £, and the town has flourished exceedingly?

Mr. Verrall: I may have seen it stated so.

Further questions elicited from Mr. Verrall the statement that he was strongly of opinion that the telephone system should be self-supporting.

Alderman Carden, who was intimately connected with the telephone undertaking, was examined at length. He considered that the loan was absolutely essential if proper facilities were to be afforded, and expressed himself satisfied with their prospects under the Postmaster-General's purchase agreement, upon which the Inspector remarked that nobody could say now what the Postmaster-General would do in 1911, "You can only put it as your hope that it may be so." The inspector was anxious to learn whether at the start any question was raised as to what the ultimate cost would be in which the Corporation were likely to be involved, and elicited that it was clear the system was one which would necessarily require an increasing capital, but that there was no idea of what the ultimate cost would be. Asked by the inspector:—

Are you ready to admit that there must be a very considerable capital expenditure?—The Witness replied: If we decided to go on till 1924. If we decided to sell to the National next year, or if we decided to sell to the Post Office next year, there would not be any.

It was elicited in cross-examination by Mr. Robb and Mr. Watts that of the 2,318 lines mentioned by the Inspector, about 25 per cent. consisted of extensions and private lines, and it was suggested that it was not fair to say that the original estimate had been carried out when some of the lines were only short extensions, costing about £5 each, and the estimate was for 2,000 lines, costing £18 10s. each. Alderman Carden expressed the opinion that "it is the most successful business we have ever taken up," and was reminded by Mr. Robb that last year it cost the ratepayers some £18,000.

Alderman Carden: They will get £18,000 back for it.

The Inspector: We must confine ourselves to facts.

Alderman Carden: That is an absolute fact.

The Inspector: No, Sir, you cannot state it as a fact; it may be your opinion.

Alderman Carden apparently holds the view that an appropriation towards sinking fund is equivalent to an allowance for depreciation, and stated that if, on the production of the year's balance-sheet, there was found to be a loss, he would be the first to suggest that the rentals should be raised. In re-examination by the Town Clerk, Alderman Carden said it was not fair to describe the expense of the undertaking as a loss. It represented interest on borrowed money, and instalments on repayment of debt, and it was impossible to meet these charges except out of the rates if they were earning no revenue.

Mr. Bennett, the consulting telephone engineer of the Corporation, was the next witness. In answer to the Town Clerk, he said that, in his view, the Brighton Corporation system was the best in the kingdom without any exception whatever, whether regarded from the points of view of clearness of speaking, silence on the lines, privacy of conversation, or certainty and continuity of service. In fact, it combined all the good features of telephony and avoided the evils.

Mr. Bennett's evidence was directed to show that the cost of the scheme under the two loans was £52,811. In Brighton there was a considerable amount of wood paving, and it had been thought advisable to put in more ducts than at Portsmouth. He strongly contended that it was necessary to take credit for the large number of extra spare wires which the policy of the Telephone Committee had caused to be laid—729, which he valued at some £5,832. This, he pointed out, would reduce the actual cost of the installation to £46,979 5s. On the subject of depreciation, Mr. Bennett said that if a subject had before it a life of 36 years, and the cost of the subject was repayable in any shorter term—say, 25 years, it was an excessive precaution to add any depreciation fund to the sinking fund. Later, he thought it a proper thing to provide a certain reserve fund, which would be ready in case of any drastic change.

The Inspector: When you made that allowance of 2½ per cent. for depreciation were you not aware that the Local Government Board were granting loans for municipal telephones for a period of 25 years' limit?

Mr. Bennett was understood to say that he could not charge his memory as to that.

The Inspector: How did you calculate the sinking fund?—I adopted 25 years.

And on that principle you still recommend there should be 2½ per cent. for depreciation?—Yes.

The Inspector: Do you expect any development in Hove?—I hope so.

Having regard to that fact, would it be advisable or not to lay ducts sufficient for what you anticipate? In telephony you have to look a little further ahead than to-morrow; the work of digging up streets is very expensive?—Certainly.

You anticipate considerable development in Hove, and yet you are laying no spare ducts?—Mr. Bennett replied that that was so, but explained that when the development came it might happen that the ducts might not be found in the best possible position; that an adjacent street would be better for the new ducts. Therefore it was not altogether a question of opening up streets.

The Inspector: Have you many spare ducts in Hove at the present time?—One spare duct.

The Inspector went into the figures and came to the conclusion that the cost of telephones in Brighton was £29 10s. per line to-day.

Mr. Bennett said he did not think it fair to include the payment of the loan which took place last year, before the money had been expended.

The Inspector: You knew very well in making the original estimates that would have to be provided for, that the Local Government Board did not allow interest accruing from loans to be charged to capital account?

Mr. Stevens, borough accountant, said that could not be taken as capital expenditure; it was a liability that would have to be met out of the revenues of the undertaking.

The matter was deferred until Mr. Stevens gave his evidence.

The Inspector (to Mr. Bennett): The telephone undertaking is one that has been liable to many changes during the last ten years, and what was in use ten years ago is out of date to-day. Is it reasonable to assume that in the next ten years there will be no further improvement?

Mr. Bennett replied in the affirmative, saying that they had attained a standard of proficiency which had taken them since 1879 to attain. Telephony was in a position of stability.

The Inspector drew attention to the improvements in instruments, observing that one now under consideration was a very drastic one.

Mr. Robb's cross-examination of this witness was apparently designed to show that he had not designed and constructed any large and up-to-date system of telephone exchange. Guernsey was merely a "glorified village system."

Questions regarding extensions and "spares" led the inspector to emphasise the necessity of having a percentage of spares, and to point out that they could not be regarded as assets, for a system could not be run without them.

Some amusement was caused by Mr. Bennett handing the Inspector one of his pamphlets on the question of extensions, remarking that it was an important point, and one that was within the limits of understanding.

He could not indicate any company in America providing as little as 2½ per cent. for depreciation.

Replying to further questions, Mr. Bennett said there were several switchboards in the country working now that were put in 12 years ago. He regarded 2½ per cent. as adequate allowance for wear and tear and antiquation. He expressed disapproval of the common battery system, and said that the Post Office system would be immensely improved by its abandonment. He admitted that in the Brighton Corporation system the operator had to restore one of the indicators, but he had since improved on this method. The present loan did not provide for that alteration, because it had not yet been formally approved. The cost of the alteration would be very slight.

Mr. D. J. Barnes, manager of the telephone system, was the next witness. His evidence was concerned with the estimates and the expenditures.

Asked whether the original estimate of £45,000 would have been nearer the mark had it been 50 per cent. more, Mr. Barnes said the original expenditure was for 2,000 lines.

The Inspector: Yes; but you won't get 2,000 subscribers for £45,000. You will only get 2,300 for £62,000.

Mr. Barnes thought £20,000 more would be required in the near future.

Replying to further questions, Mr. Barnes said the Corporation went to Steyning as part of the original scheme.

The Inspector: Without a subscriber? What would it cost? £1,000 or so? Some considerable sum, at any rate. You went out there on chance? Is that business? Would you with your own money run a line to Steyning at £1,000, with the result that after 18 months' working you had one subscriber? I am putting you this question pretty straight. It is rather a serious question with regard to the excess of expenditure over the original estimate.

Mr. Barnes: We have call offices.

The Inspector: Never mind the call offices. What is the total rental you receive?

Mr. Barnes: £5.

The Inspector: Hardly successful, is it?

The Town Clerk observed that the Steyning exchange had only been open six months—not 18 months.

The Inspector: Whether it is 18 or 6 months, people who wanted to join would have joined by now.

Replying to the Town Clerk, witness said the average earning of each instrument was £3 15s. 3·09d.; average expense, £2 3s. 9·9d.; average gross profit, £1 11s. 5·139d.; average loan charges, £1 6s. 10·07d.; average net profit, 4s. 7·069d. The number of calls per subscriber was 5·76. There were 1,053 subscribers at £5 10s.; 175 at £3 10s.; 14 at £4 4s.; 16 at £3. There were 96 public telephones; 11 service telephones; 300 exchange extension telephones; and 155 private telephones. The average number of orders received was 10 per week. The public telephones brought £7 in each per week.

Mr. Stevens, the borough accountant, gave evidence regarding the accounts, and the Town Clerk intimated that with his evidence the case for the Coporation was closed.

The Inspector, however, desired to hear Mr. Lintott, the present chairman of the committee.

Mr. Lintott's evidence was mainly directed to show that he had no special knowledge of the business, and that his committee had not considered the effect of the agreement between the Post Office and the National Co.

The opposition was opened by Mr. Robb calling a witness, who handed in a petition containing the names of 2,904 ratepayers, representing a rateable value of £108,912, praying the Local Government Board not to grant the loan. This witness was succeeded by Mr. White, a hotel proprietor at Hove, who amused everyone vastly by the dry, sententious wit of some of his replies to his interrogators, and declined to believe that any extension of the scheme was essential to the interests of the ratepayers. There was no necessity, he thought, to carry the system further into Hove.

"If this were your own business," inquired Mr. Robb, "would you regard it with the same glowing terms as Mr. Carden?"

"Sir," replied the Witness, solemnly, "I should at once consult my solicitor, and call my creditors together!"

Mr. Herbert Laws Webb was the expert witness called for the opposition. His evidence was directed to show the unreliability of Mr. Bennett's estimates and the improper technical features of Mr. Bennett's engineering.

Mr. Robb summed up the case for the opposition. It was a sad thing to see the resources of a great town frittered away by careless and ignorant people. He had nothing to say against the excellent motives of the Brighton Corporation, but, unfortunately, they were utterly ignorant of the principles of telephone management. In the first place they began with superficial, delusive and altogether insufficient estimates, prepared without the slightest conception as to the essential trend of the business. Those estimates were exceeded by a large percentage. Heaven and earth had been moved to make the enterprise a success—with the only result that at present it was in a deplorable state of failure, both from a technical and commercial point of view. Concluding, Mr. Robb said the Corporation had entered upon this scheme without any prudent precautions, and, worse than that, they were seeking to continue it without any definite policy, in view of the utter and extremely serious condition of affairs. The Corporation should put their pride in their pocket, admit their error, and consider, in the ratepayers' interests, the desirability of coming to some reasonable arrangement with their rivals, instead of persisting in competition which would only lead to financial disaster and a heavy charge to the ratepayers in the near future.

Briefly replying on behalf of the Corporation, Mr. Talbot dwelt on the fact that the Corporation only entered into the business because the National Co. would not grant reasonable facilities. He pointed out that the Government strongly encouraged municipalities to go in for the business, and now that there had been a development of Government policy, which was to result in its taking over the National system, he did not think that this Corporation should be restricted and confined in the development of this undertaking in a way which he considered extremely unfair. The Corporation should have a fair innings with the undertaking, and have such further facilities afforded it as were reasonably necessary.

Offering a word of explanation as to the excess on the original estimate, Mr. Bennett said that 31 miles of ducts had been laid, whereas only 18 miles 1,440 yd. were provided in the original specification.

The Inspector pointed out that the latter did not include the 14 miles laid by the tramways.

Mr. Bennett also pointed out that 1,329 spares had been provided, as against the 600 estimated. The ratepayers would have considerable value in return for the excess expenditure.

The inquiry shortly after closed.

BUSINESS NOTES.

Exports of Electrical Machinery.—The value of the electrical machinery exported from this country during April last is returned at £33,061, bringing up the total for the first four months of the year to £201,825 as against only £129,157 in the corresponding four months of 1904.

France.—The balance-sheet of La Compagnie d'Electricité Thomson-Houston de la Mediterranée for the last financial year shows a profit of £35,076.

Belgium.—The Antwerp Telephone and Electrical Works Co. reports a profit of £4,795 for the last financial year.

The Canary Islands.—The balance-sheet of La Société d'Electricité de Las Palmas (Canary Islands) for the last financial year shows a loss of £6,076.

Electrical Mining Machinery.—Messrs. Ernest Scott and Mountain, Ltd., have recently received a contract from the Butterley Coal Co., of Darby, for their Kirkby Colliery in Nottinghamshire, the installation consisting of two horizontal compound condensing steam engines, each of 450 H.P., driving on to slow-speed three-phase generators, each of 310 KW. capacity. This plant will supply current to four endless rope haulage gears placed underground at distances varying from 20 yards to 650 yards from the shaft bottom, the haulage gear bringing the coal from long distances in-bye. The haulage gears are driven by three-phase motors of Scott & Mountain's latest design, each motor being capable of giving 100 effective H.P., and the haulage gears are provided with the firm's special type of friction clutch and friction brakes. A complete system of telephones is also being arranged between each haulage room and the main power station at bank. One generating set is of sufficient size to drive the four haulage gears, and the second set is to be used as a stand-by, and for driving pumping and other machinery at the surface.

The Wigan Coal and Iron Co., Ltd., have also decided to increase their electrical plant at the Manton Colliery, and have placed this work in the hands of Messrs. Scott & Mountain, who recently carried out an installation for pumping and hauling machinery at their Sovereign pit. The plant at the Manton pit will consist of three compound horizontal steam engines and crankshaft alternators, each of 550 H.P. In addition to this there is a continuous current generator capable of supplying 2,500 lights which are being installed for lighting at the surface and underground, and also the houses of the officials and workmen. The pumping machinery at Manton Colliery consists of five sets of Scott & Mountain's well-known mining pumps, each set being capable of delivering up to 1,000 gallons of water per min., each pump being driven by a motor of 125 effective H.P. It is thought that this pumping plant is probably one of the largest at work in the United Kingdom.

We also understand that Messrs. Scott & Mountain have a considerable number of other important contracts in hand, including installations of mining machinery for the Mickley Coal Co., Ashing Coal Co., Harton Coal Co., North Navigation Collieries Co., Swalwell Colliery Co., Shelton Steel and Iron Co., Consett Iron Co., Bell Bros., Ltd., Cammell Laird & Co., and others, and are extremely busy in their new works at Gateshead which have now been completed, giving the firm increased facilities for producing all classes of engineering work and electrical machinery.

Dissolutions and Liquidations.—The Wear Electrical Engineering Co. is winding up voluntarily, with Messrs. J. G. Kirtley and T. Harrison, of Sunderland, as liquidators.

Messrs. J. M. Morrish and C. A. Esmarch (Cecil A. Esmarch, Morrish & Co., electrical engineers, plumbers, &c., Middlesbrough) dissolved partnership as from August, 1903, and in the *London Gazette* it is notified that the business has been since carried on as Esmarch, Morrish & Co., who will attend to debts of the old firm.

A meeting of the Langdon-Davies Motor Co, Ltd., will be held on Monday, June 19th, at Southwark Works, Deverell Street, S.E., to hear an account of the winding up from the liquidator (Mr. F. B. O. Hawes). This notice, of course, relates to the old company which was recently wound up for purposes of reconstruction.

The liquidation was merely a formal matter, but when the reconstruction took place there were several alterations on the board, Mr. Hawes being made chairman and general manager. Messrs. W. Langdon-Davies and A. Soames are consulting engineers to the company, and are not on the board.

A meeting of the Northern Counties Electric Traction Co., is to be held at Windle Chambers, Hardshaw Street, St. Helens, on June 19th, to hear an account of the winding up from the liquidator (Mr. Wm. Spencer).

The shareholders of the British Prism Globe Electrical Co., Ltd., on 16th inst. resolved to wind up, as the company cannot, by reason of its liabilities, continue the business. Mr. Wm. Dearden, of 36, Spring Gardens, Manchester, was appointed liquidator.

Car-Building Amalgamation.—It is stated in the *Lancashire Post* that an extraordinary general meeting of the Electric Railway and Tramway Carriage Works Co., Ltd, Preston, is to be held for the purpose of authorising the directors to enter into contracts relating to the purchase of the Castle Car Works (late G. F. Milnes), at Hadley, Salop, and the British Electric Car Works, at Trafford Park, Manchester. "These works, the directors state, were active competitors of their company, but recently went into liquidation. The works were offered for sale, and were purchased jointly by Mr. John Kerr, Mr. Geo. Flett, Mr. Wm. S. Laycock, and the Metropolitan Amalgamated Railway Carriage and Wagon Co., Ltd. The purchasers have offered to re-sell both works to the Preston Co. for £85,000, which includes a profit of about £20,000 on the original purchase price. It is proposed to issue £100,000 of 6 per cent. preference shares of this company, which will provide £85,000 to purchase the works, and £15,000 for additional working capital, each of the four vendors agreeing to underwrite or procure subscribers for one-fourth of the issue."

Strike.—The *Manchester Courier* says that as a result of the negotiations that have taken place between the management and representatives of the men, the strike of instrument-makers at the Westinghouse Works, Trafford Park, is practically ended.

New Insulator.—A new insulating material, called "Galatite," and resembling ebonite in its qualities, but possessing greater elasticity, has been manufactured from the milk of cows in Germany.

Gas Engines and Storage Batteries.—*A propos* of the note on this subject in our last issue, the Chloride Electrical Storage Co., Ltd., have drawn our attention to their Circular No. 5, which describes, with illustrations, a country house installation consisting of a suction gas producer, gas engine and dynamo of 25 KW., and Chloride battery having a capacity of 900 ampere-hours. There are no regulating cells on the latter, regulation being effected by means of resistance when discharging—a very good arrangement, in our opinion; it is far better to waste a little energy than to have troublesome end-cells to deal with, besides being cheaper in first cost, and exceedingly simple in operation. The plant in question supplies a total equivalent to 1,000 8-C.P. lamps installed, in addition to a number of fans, heaters, &c.

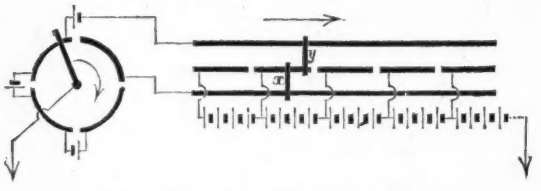
Holiday Literature.—The Great Eastern Railway Co. have just issued the 26th annual issue of their Tourist Guide to the Continent, edited by Percy Lindley. The new features include particulars of tours in the Tyrol, North Germany, and Scandinavia, by the Harwich-Hook of Holland route, as well as tours in the Luther Country, Hartz Mountains, &c. The book is tastefully illustrated, and is interesting in itself as well as a most useful travelling companion.

Trade Announcements.—Mr. P. C. P. Richardson, late manager of the Electrical Fittings Co., Ltd., has commenced business at 16, Dorset Street, Baker Street, W., as the Richardson Electrical Co., Ltd. Mr. E. H. Walker, late chief designer to the Electrical Fittings Co., and formerly assistant designer to the General Electric Co, has joined Mr. Richardson in partnership. Electrical fittings, art metal work, &c., will be the company's special line.

Mr. C. R. Heap removed from 47, Victoria Street, S.W., to 28, Hatton Garden, E.C., on Monday last (15th inst.).

Messrs. J. C. & G. F. Mort have, as the New Engine Co., opened the Acton Hill Works, Acton, W., for the manufacture and repair of motor-cars. The works, which have an area of 15,000 sq. ft., are equipped with the latest tools for this class of work.

"New" Battery Switch.—Regarding the system of battery regulation described in our last issue, Messrs. Veritys, Ltd., write drawing our attention to Heath & Field's patent battery regulating switch, which was designed seven years ago, and of which they are the sole manufacturers. As will be gathered from the following description, there appears to be a remarkably close resemblance between the two systems, the only material difference resting in the fact that Messrs. Veritys have elected to carry out the regulation entirely from one end of the battery only. The main switch consists of an ordinary battery switch containing four contacts. The spindle from this switch passes through the slate, and is provided with a small pinion which engages a gear-wheel attached to the spindle of another switch, fixed on a slate supported at some distance behind the main switchboard. On the back of this supplementary slate is mounted the second accumulator switch, containing five contacts. The whole arrangement is shown diagrammatically in the accompanying figure. The regulator is here arranged for giving 20 different pressures. Three cells are connected to the respective contacts of the front switch, while 16 cells are connected in sets of four, with a total of five cables, to the five contacts on the back switch. The two switches are geared together in such a manner that for every revolution of the front switch the back switch-arm moves one contact forward. The effect of this is the reduction, one by one, of the number of cells in circuit, for, when the front switch has completed one revolution, it has thrown out the three regulator cells first referred to. The switch-arm of the back switch by



Heath and Field Battery Switch.

this time makes contact with the first cell of the next group of four and the process is again repeated by the switch throwing out cell after cell of the three regulator cells until the next group of four is reached. In the case of a regulator with nine contacts—that is, four on the front face and five on the back, as in the instance taken—a combination of $5 \times 4 = 20$ different pressures can be obtained on the circuit regulated. It will be seen from the figure that the five-way switch is provided with a pair of brushes. These are insulated from each other, and make contact with separate rings, the object being that continuity of the main current shall never be broken during action. While each of the brushes is breaking contact, it carries no current, so that the movement, which is comparatively slow, can never cause any sparking whatever. The arm of the four-way switch on the front of the switchboard bridges the gap between the consecutive cells with a low resistance carried by means of a small parallel arm inserted in the usual way. The directional arrows in the diagram are simply to indicate simultaneous movements of the arms on the two faces, the regulator itself being, of course, capable of working in both directions. The number of cables required to be run from the switchboard to the battery is, except for small batteries, less than half the number necessary with the ordinary form of switch. With 25 steps only 11 cables are required; 30 steps require 12 cables, and 36 require 13. A segment dial painted with numbers representing the actual cells in circuit at any time is provided, and indicates the position of the switch with reference to its range.

Brush Contracts.—The following new contracts have been booked by the Brush Electrical Engineering Co.:—

A 300-kw. steam dynamo and switchboard extensions, for the Merthyr Electric Traction and Lighting Co.

Six double-deck four-wheel cars with Raworth regenerative control equipments, for the Plymouth Corporation.

Twenty single-deck composite motor-cars mounted on radial trucks, for the North Metropolitan Electric Tramways Co.

Ten double-deck four-wheel car-bodies, for Stockport (per B.T.H. Co.).

Dry Battery Litigation.—Some 18 months ago legal proceedings regarding an alleged infringement of dry batteries claimed considerable attention. This action has now, in consequence of a recent decision in the House of Lords, been revived. We understand that many firms in the trade contemplate resisting vigorously this renewed attack, and a preliminary meeting took place the other day. Some reference to the matter appears in our advertisement pages to-day, and we are asked to say that those who are interested in the movement should communicate with Mr. Walter Davenport, secretary to the Electrical Manufacturers' Association (Incorporated), Ridler Place, Holland Street, Blackfriars, London, S.E.

Book Notices.—*Der Wahlweise Anruf in Telegraphen und Telephonleitungen und die Entwickelung des Fernsprechwesens.* By J. Bauman. München: R. Oldenbourg. 1905. Price M. 2.50. Owing to the constant advances in the telegraph and telephone industry, a great part of the useful literature of this subject is contained in the current technical press, whilst the standard text books are, on the whole, far from up to date. The series of which this little book forms the first volume is being published as an attempt to bridge the gap between these two sources of information. Each volume will contain a general survey of some particular and well-defined branch of the subject, together with an indication as to the probable direction in which future advances may be looked for. Besides this first volume on "Selective call systems," a number of others are in hand, including volumes on "House Telegraphs and Telephones," "Military Telegraphy," "Relays," "Telephone Exchanges," "Wireless Telegraphy," &c. Judging from this volume, the result should be satisfactory, as the limited field dealt with and the space available allow the treatment to be fairly full, especially as a previous working knowledge of the subject is assumed, and as mathematical proofs as well as descriptions of constructional details are avoided. The book gives a fairly clear and comprehensive description of the various systems of selective signalling in use in telegraph and telephone work, together with a critical examination of the advantages and disadvantages of each and of its relation to future advances. The scope of the volume will be best understood from the titles of the eight chapters into which it is divided:—I. Selective Call Systems in Connection with Permanent Current Morse Lines. II. Selective Call Systems in Connection with Working Current Morse Lines. III. The Apparatus. IV. The Use of a Single Line Common to several Telephone Stations. V. The Selective Call System for Long-Distance (Double) Lines. VI. The Selective Call System for Telephone Installations in Reference to the Cost Question. VII. Direct Connection into Local Circuits and the Use of Automatic Sub-Stations. VIII. General Form of the Installation and Methods of Working Telephone Networks.

Decimal Coinage and the Metric System of Weights and Measures. By E. Anthony, M.A. London: G. Routledge & Sons. 1905. Second edition. Price 2s. 6d.—In this edition of Mr. Anthony's comprehensive study, attention is called to the opinion of Mr. A. Carnegie, which is now incorporated, and some additional extracts from various publications, both for and against the metric system. The author has studied the subjects dealt with for many years, and is an enthusiast in favour of the adoption of decimal coinage, by introducing a new gold coin of value 100d., and of the metric system of weights and measures. Thanks to his candid exposition of both sides of the question, the work constitutes a useful handbook on the whole subject.

A Short Introduction to the Theory of Electrolytic Dissociation. By J. C. Gregory, B.Sc., A.I.C. London: Longmans, Green & Co. 1905. Price 1s. 6d. Although this little introduction to the dominant theory of the electro-chemist is pleasantly and clearly written, one cannot help thinking that there is little justification for the multiplication of highly specialised elementary books of this kind. There are now several excellent English text-books dealing with physical chemistry as a whole, and we can think of no class of reader for whom one or other of these text-books—which all contain an account of the ionic theory—is not admirably suited. No possible good can be gained from the study of a single branch of physical chemistry by a person, whether he be a chemist, a physicist, or an engineer, who is ignorant of the fundamental principles of that science. It is just this kind of superficial and one-sided study which leads to dogmatism in science, and to the misunderstanding and misuse of scientific hypotheses. At the same time, if one must have books such as this, Mr. Gregory's excellent and lucid method of writing them can very well be taken as a model. The four chapters are as follows:—The Condition of Dissolved Substances; Ions and Precipitation; The Hydrogen and Hydroxyl Ions; Some Electrolytic and General Considerations.

"Gas Engines and Producer Gas Plants." By R. E. Mathot; translated from the French by W. B. Kaempffert. London: Crosby Lockwood & Son. 1905. 12s. net.

"Les Enroulements Modernes des Dynamos à Courant Continu." By A. Meynier and H. Nobiron. Paris: Ch. Béranger. 4 fr.

"Report of the Lightning Research Committee." London: 9, Conduit Street, Hanover Square, W. 1s.

"Twenty-third (1905) Annual Catalogue of the Rose Polytechnic Institute." Terre Haute, Indiana, United States.

"Précis d'Hydraulique: La Houille Blanche." By Raymond Busquet. Paris: J. B. Baillière et Fils. 5 fr.

"L'Aérovoie, une Solution Pratique du Problème de la Locomotion Aérienne." By Dr. Federico Sacco. Turin: L'Ecole des Ingénieurs.

Catalogues and Lists.—Brush Electrical Engineering Co., Ltd. Well illustrated price list of electric fans, direct and alternating, for desk, wall or ceiling use, for the coming season. Details as to blade diameters, pressures, weights, code-words and prices are very clearly set out. The Brush battery and lampholder fans, cabin and saloon, port-hole and box-blade fans are shown.

Alliance Electrical Co., Ltd., 23, Grafton Street, W. Pamphlet detailing the Alliance variable speed motors, and showing their application to capstans, lathes, pumps, &c.; test curves are given.

Sir Hiram Maxim Electrical Co., Ltd., Gillingham Street, Westminster, S.W. This company, which has taken over the manufacturer of the Maxim arc and incandescent lamps, but has no connection with the sale of lamps belonging to the old company, has just issued a new catalogue of lamps and electrical accessories. A large number of incandescent lamps for lighting and heating are shown full size, including tubular, crinkled, half-opal, silvered, and other types, and lamps for train and tramcar lighting. The "Maxim" enclosed arc lamps receive a good deal of attention, and balancing coils, carbons, switches, fuseboards, lampholders, and many small accessories and devices are enumerated.

Messrs. Ferranti, Ltd., Hollinwood. Catalogue No. 15, detailing their Idle Current ammeter for measuring the wattless current in two or three-phase circuits.

International Electric Co., 55, Redcross Street, E.C. New illustrated price list of electricity meters. Very full descriptive particulars are given of the type A.G. direct current and type A.W.

alternating current watt-hour meters. Prices are also published of E.G. ampere-hour meters.

Messrs. Walter Locke & Co., Ltd., Calcutta. Catalogue of electric light fittings and accessories, motors, fans, telephones, electric bells, with illustrations, also prices.

Messrs. Siemens Bros. & Co., Ltd. Two new leaflets. No. 562 gives dimensions, weights and gearing ratios of their G.A. motors with geared countershaft. Full particulars of the motors are described in the firm's leaflet No. 560, recently issued, the outputs varying from 25—150 B.H.P., depending on whether the motors are protected, ventilated-enclosed or fully enclosed. Specification 7B describes their new type of 5B and 5BA machines, protected, ventilated-enclosed, and fully enclosed. The outputs vary from 1 B.H.P. to 3 B.H.P., depending on whether the motors are protected or fully enclosed, and for the protected dynamos from 1·7 to 2·6 KW.

Messrs. Doulton & Co., Ltd., Lambeth. Illustrated catalogue of their patent automatic water-softeners and purifiers for electricity works.

Messrs. Crane & Co., 95, Queen Victoria Street, E.C. Nos. 3 and 4 of the *Valve World*, a monthly publication issued by the Crane Co.'s Chicago establishment, mainly devoted to their steam specialities.

Messrs. Ernest F. Moy, Ltd, Camden Town, N.W. Illustrated sheet No. 119, relating to their feeder pillars for traction and lighting systems.

The Sturtevant Engineering Co., Ltd., London, E.C. List of organ-blowing fans, one of which, supplied by the company, has been employed for the organ at Westminster Abbey for some time past.

Electric Light and Calico Prints.—In regard to the letter which appeared in our issue on May 5th on this subject, the Union Electric Co., Ltd., call attention to their "Coltru" daylight arc lamps, particulars and illustrations of which appeared in our issue of the October 21st, 1904. These lamps are claimed to present many advantages in practical working, and to be exceedingly economical in current and carbon consumption.

For Sale.—On May 29th and 30th Mr. J. G. Lambert will sell by auction certain electrical plant, tools, &c., under dissolution of partnership of G. H. Woods & Co. Particulars appear among our advertisements to-day.

LIGHTING AND POWER NOTES.

Australia.—Sydney.—The suburb of Newtown is considering the electric lighting of its district, and is conferring with Mr. A. C. F. Webb, electrical engineer, of Sydney, on the question.

The City Council has proposed to supply Paddington, and erect electric lamps in the borough, the charge per lamp to be £21 all night, or £12 10s. till midnight. The matter is being favourably considered by the local council.

Barnsley.—During the past year the electricity undertaking of the T.C. yielded a gross profit of £5,950, and a net surplus of £1,857, of this sum £550 goes to the relief of the rates.

Bourne.—The Urban Electric Supply Co. has canvassed the district to ascertain the probable number of consumers for electric light, should it decide to establish works in the town. The local tradesmen's association discussed the matter, and asked the company to look into the question.

Brixham.—Edmundson's Electricity Corporation has written to the U.D.C. proposing to provide the capital required for lighting the town by electricity, on condition that the Council guarantees £500 a year for street lighting. The estimated cost of laying the cables from Dartmouth to the town, together with the distributing cables, is between £8,000 and £10,000. The Council has referred the matter to a Committee for consideration.

Canada.—Montreal.—The Montreal Light, Heat and Power Co. has recently installed a new two-stage electrically-driven pump at its Clarke Avenue pumping station, with a view to overcoming the vibration that was set up by the one previously installed. Messrs. Mather & Platt are the manufacturers, and it has a 24-hour capacity of 5,500,000 gallons against a head of 300 ft., as against 4,500,000 gallons by the one just discarded. This new pump is driven by a 500-H.P. induction motor, and is said to be the largest of its kind in Canada. It is the company's intention, provided this proves a success, to install a duplicate set.

Castleford.—The U.D.C. on May 11th decided to invite Messrs. Medhurst, Page & Lloyd, of Manchester, to submit a scheme of electric lighting in connection with a refuse destructor.

Continental Notes.—Italy.—La Società Idro-Elettrica di Cerro al Lambro has just been formed with a capital of £24,700, to work a hydro-electric power plant, which it intends to construct on the River Lambro, at Cerro, for supplying the district with electricity.

The "Société pour les Forces Motrices de l'Anza," of Milan, has obtained a commission to utilise the flow of the River Anza at Calasca for the generation of electric energy.

Turin has also given sanction to a water power scheme on the Doire Baltée.

Spain.—A concession for the erection of a hydro-electrical plant at Girzueta has been granted.

A company has just been formed at Cindad Real for the purpose of exploiting the water falls of Ruidera, with the object of supplying electric energy to Manzanares, Solana, Membrilla, and Valdepenas.

Germany.—The Rhenish Westphalian Electrical Co. is about to erect an electricity works at Kastrop, Westphalia.

Poland.—La Société Metallurgique Hantke, at Tchenstokhoff, is putting down an electrical generating plant for the operation of its steel rolling mill.

Darlington.—Mr. J. R. P. Lunn, the borough electrical engineer, recently submitted his report on the past year's working to the E.L. and Tramways Committee. The number of units sold, exclusive of traction, increased by 41 per cent.; the revenue from lighting and power increased by £957, in spite of a reduction of ½d. per unit in the charge for energy. Total working costs per unit were ·98d., as against 1·83d. in the previous year. The net profit on the year's working was £1,500, and Mr. Lunn suggests a further reduction in the price of electricity for lighting and power, as follows:—For lighting, to 4d. per unit; for power, from 2d. and 1½d. to 1½d. and 1¼d. (first 500 units per quarter at the maximum price). The report was adopted.

Devonport.—The net profit made by the Corporation electricity undertaking amounts to over £2,000, against £1,900 in the previous year. The surplus will more than liquidate the suspense account.

Durham County.—The prov. order for E.L. granted by the B. of T. to the County of Durham Electrical Power Distribution Co., Ltd., authorises the company to supply energy within the parishes and townships of Bearpark, Belmont, Broom, Cassop-cum-Quarrington, Coxhoe, Framwellgate Moor, Hett, Kimblesworth, Neville's Cross, Pittington, St. Oswald's, Shadforth, Sherburn, Sherburn House, Shincliffe, Sunderland Bridge, and Whitwell House (in the Rural District of Durham); and Barmston, Birtley, Bourn Moor, Cocken, Edmondsley, Great Lumley, Usworth, Harraton, Lambton, Lamesley, Little Lumley, Ouston, Pelton, Plawsworth, South Biddick, Urpeth, Waldridge, Washington and Witton Gilbert (in the Rural District of Chester-le-Street).

East Ham.—The U.D.C. has reduced the price of energy for power from 2½d. per unit to 2d.

Hampton.—The U.D.C. has withdrawn all opposition to the Bill promoted by the Metropolitan Electric Supply Co., certain clauses having been amended to meet the wishes of the Council.

Harwich.—The E.L. order obtained by the T.C. in 1903 has been revoked by the B. of T. An extension of time was applied for, but not allowed. In reference to the matter the Mayor expressed the opinion that electrical energy would be distributed in bulk and sold at a cheaper rate in a few years' time than it could be by a small municipality.

Huddersfield.—Following a canvas conducted by the borough electrical engineer, the Electricity Committee has decided to extend the mains to Mount, Outlane.

India.—A Bombay paper says that a licence for the supply of electrical energy within the municipality of Delhi has been granted by the Punjab Government to Mr. Arthur Grey, a barrister of Lahore, and the firm of Messrs. John Fleming & Co., Bombay. The licensees are required to pay the Municipal Committee in respect of any tramways constructed, a yearly rent of Rs. 800 per mile of double track and Rs. 500 per mile of single track.

Simla.—A scheme for a small municipal electrical installation costing Rs.22,000 to light the Town Hall and a portion of the Mall, has been approved by the Simla Municipal Committee and submitted to the Punjab Government. This is quite independent of the big water power electric scheme for Simla, which is also under consideration, but which will necessarily take several years to construct.

The Punjab Government has sanctioned the large E.L. scheme for Simla, but is not prepared to share its moiety proposed for the expenses attendant on the improvement of water works with a view to providing funds. The municipality has under consideration a proposal to enhance the water rate to balance the burden on the public, and it is also contemplated to abolish servants' and other minor taxes. The first installation of the electric light will be across the Ridge, and the power house will be located where the Navti Khud joins the Sutlej.—*Indian Daily News.*

Ilford.—The U.D.C. has fixed the price of energy for the tramways at 1½d. per unit.

London.—Southwark.—Municipal trading has evidently not given rise to much satisfaction, so far as the electric lighting undertaking of this municipality is concerned. Questions as to the financial state of affairs are not permitted to be answered by the clerk until Lord Camperdown's Committee has finished sitting. The Mayor, at a meeting last week, appealed to the members not to touch upon E.L. matters in Council for another six weeks. "Whatever they said against their municipal electric light would be used in the House of Lords, and the investigation there proceeding would be affected by them." A motion on the agenda paper that the Council sell the undertaking was not allowed to be put to the meeting, nor discussed. The meeting was of a very disorderly character. The reasons for not allowing the matter to come up for discussion are quite obvious, and the whole affair is typical of the way in which municipal trading is carried on in Southwark.

Hornsey.—The B.C. has decided to light Stroud Green Road with flame arcs. Nernst lamps are to be fitted to the columns for use after midnight.

L.C.C.—At the meeting on Tuesday the Council resolved to advance £6,500 to the Woolwich B.C. for the extension of mains.

SHOREDITCH.—£975 is to be expended on a clinker crushing plant to be erected in the destructor yard, and a further sum of £200 upon demand indicators.

WESTMINSTER.—As a result of an experiment with a "Midget" arc lamp, which the Westminster Electric Supply Corporation erected, the C.C. has decided that they be used for public lighting in the parish of St. George, Hanover Square, where ordinary arcs are not required, and where incandescent lamps have been used up to the present. The company will supply and maintain these new lamps at the rate of £7 10s. per annum.

HAMMERSMITH.—To meet the anticipated increased demand from the reduction in the price of energy, eight sub-stations are to be built at an estimated cost, including the switchgear and the necessary works, of £2,508.

BERMONDSEY.—The annual financial statement in connection with the B.C. E.L. undertaking was presented on Tuesday last. The works expenditure amounted to £7,711. The income was £12,016, leaving a gross profit of £4,271. Interest on mortgage debts (£2,801), instalments of principal (£363), and payment to reserve fund (£499) absorb £3,663 of this sum, and £1,000 is added to the reserve fund. The number of units generated during the year's working was 1,039,503 units, 282,185 units being supplied to public lamps, and 649,914 to private consumers by meter.

Lowestoft.—On Friday last a L.G.B. inquiry was held into the application of the T.C. for a loan of £1,500 for E.L. purposes—the provision of additional boiler plant. There was no opposition.

Old Windsor.—The B. of T. has granted the application of the Windsor Electrical Installation Co., Ltd., for a prov. order enabling it to supply energy in the parish.

Paignton.—On the recommendation of its Lighting Committee, the T.C. has resolved to apply to the L.G.B. for sanction to a loan of £18,500 for E.L. purposes.

Partick.—The Electricity Committee of the T.C. is to apply to the Secretary of Scotland for sanction to borrow a further sum of £3,000, to be expended next year on extensions.

Swansea.—The L.G.B. has requested the T.C. to make provision in this year's accounts of the E.L. undertaking for a sinking fund, on the usual scale, and dating from the commencement of the undertaking. In consequence it is estimated that the accounts will show a deficit of between £1,800 and £2,000.

Walthamstow.—A L.G.B. inquiry was held last week into the U.D.C. application to borrow £1,500 for E.L. purposes.

Whickham.—The County of Durham Electrical Power Distribution Co. has asked the U.D.C. to consent to overhead mains being carried through the district. In return the company offers to supply energy at 3¾d. per unit, less 5 per cent. The Council has referred the matter to a committee for consideration.

Wimborne.—The B. of T. has granted a provisional order for electric lighting to the Poole Electricity Supply Co., Ltd., the area of supply comprising the parishes of Wimborne (U.D.C.), Canford Magna, and Kinson (Poole R.D.C.), and Colehill, Hampreston, Pamphill, and West Parley (Wimborne and Cranborne R.D.C.).

TRAMWAY AND RAILWAY NOTES.

Ardrossan.—At a meeting of the County Council a letter was read stating that the scheme for constructing a tramway line between Ardrossan and Stevenston had taken definite shape, the promoters intending to apply for a prov. order in November next. It is proposed to start the line at a point between Ardrossan and West Kilbride, and continue it through Ardrossan, Saltcoats and Stevenston, terminating near the G. and S.W. Railway bridge.

Bath.—The Light Railway Commissioners have submitted the Bath Electric Tramways (Light Railways Extensions) Order to the B. of T. for confirmation.

Burnley.—The completed Burnley municipal tramways have now been working a year, and the financial result is regarded with satisfaction. There have been carried during the year over 10,000,000 passengers, and a gross income has been produced of £54,026. Working expenses amounted to £40,953, leaving £13,400; and after paying interest and sinking fund and other charges, there is left a balance of £1,096, which will be added to the reserve fund, making the latter £7,841.

Burton-on-Trent.—Last year the Municipal tramways yielded a gross profit of £5,161, and a net profit of £557.

Continental Notes.—AUSTRIA.—A service of electrical motor-omnibuses, taking their current from an overhead conductor, is to be established between Gmunden and Scharnstein.

SPAIN.—A new electric tramway is about to be constructed at Valencia between the Portillo de Embajadores and the Glorieta del Puente de Toledo.

The tramway company of Carthagena has been authorised to establish electric traction on all its lines.

Glasgow.—Two drivers in the employment of the Glasgow Corporation have been fined a guinea each for driving their cars in a reckless manner, whereby the vehicles collided with one another. Both cars were making for the same points travelling in the one direction when they ran into one another, one of the cars being knocked off the rails. The magistrate, in giving judgement, said that he was quite satisfied that driver McLennan had the right of way according to the tramway regulations, but those regulations, he added, were for guidance, and not for exoneration in the event of an accident, such as the case dealt with. It was clear to him that there had been recklessness, and he found the charge against both proven.

Great Yarmouth.—The B. of T. has sanctioned the construction of the Admiralty Road extension of the tramways.

Huddersfield.—An agreement between the T.C. and Messrs. E. Sykes & Sons for an extension of the system to Gosport Mills for the purpose of coal haulage has been completed.

The car drivers have requested the Tramways Committee to equip each car with a double purchase brake, and the matter has been referred to a sub-committee.

Hythe and Folkestone.—Another syndicate has informed the local authorities that it is applying for powers to construct electric tramways between these towns. Hythe T.C. has decided to grant an interview to the promoter of the scheme, Mr. Stephen Sellon.

Liverpool—Southport Electric Railway. — The L. & Y. Railway Co. having determined that full provision shall be made in case of emergency on the electric railway between Liverpool and Southport, has decided to erect four storage battery stations in connection with the electrified line. These stations are now being erected at Liverpool, Freshfield, Hall Road and Southport, and they are of good size and calculated to meet all contingencies that may arise. The buildings are to be completed by July. At the present time there is plenty of power available at the existing generating station, and it is only in case of emergency that the service will be fed from the new reserve stations.

On Friday afternoon (12th) an accident, somewhat similar to that which occurred at Formby the previous week, happened near Birkdale Station. The 3.10 p.m. slow train out of Liverpool had nearly reached Birkdale Station when smoke was seen issuing from beneath the rear coach. The train was pulled up at the station and some of the passengers alighted. Those who were left in the coach affected were asked to leave. An examination revealed the fact that a fire had broken out in the rear of the compartment's underworks, where the motors are situated. The guard's compartment was filled with smoke, the fumes, in fact, being fairly dense. The coach was quickly unhitched from the remainder of the train, and one of the chemical extincteurs carried in the train for use in case of emergency was promptly employed, the fire being quickly put out, though the rear portion of the coach was scorched. There was an entire absence of panic, and much praise is due to the company's officials for the commendably business-like way in which they dealt with the accident. The remaining three coaches were sent on to Southport and the damaged coach placed in a siding. Mr. H. E. O'Brien, resident electrical engineer of the company, and an assistant, made a close inspection. Although in certain quarters much has been made of these outbreaks, the fact remains that they were much more trivial than is generally supposed. The floors of the carriages are fireproof, so that the outbreak would have to be very intense before the safety of the passengers would be involved. The accident under notice originated in a flash from the controller, which resulted in a short circuit.

Between 10 and 11 o'clock on Sunday night a carriage was standing in the siding at Hall Road Station, undergoing repairs, when a workman accidentally caused a short-circuit, with the result that the carriage caught fire. The workmen immediately cut off the current, and the flames were subdued without causing much damage. Mr. O'Brien, the resident electrical engineer, visited the place, and the damaged carriage was removed to Southport. The electric current had to be turned off, and a delay was caused to the traffic in consequence.

London.—LAMBETH.—At the meeting of the B.C. on the 11th inst., the Finance Committee recommended that a contribution be made of one-third of the total cost, estimated at £75,500, of the street widenings necessary under the L.C.C.'s scheme for electrifying the Norwood tramways. An amendment, practically amounting to a direct negative, was proposed by Mr. Evans, who argued that if the Council accepted the very fair offer of the company, the borough could get the electrification carried out for nothing. The amendment was rejected, and the Committee's recommendation adopted.

L.C.C.—At the resumption of business on Tuesday, the Council proceeded to consider the annual estimates for 1905-6. Lord Welby, Chairman of the Finance Committee, in introducing the estimates, stated that satisfaction would be felt at the improvement in the working of the Southern tramways in the past year. It appeared from the latest figures that the profit on working would be larger than originally estimated by a sum of £35,000. The greater portion of that sum was proposed by the Highways Committee to be employed (1) in paying off the debt incurred on the temporary generating stations, and (2) in increasing the renewals reserve fund, thus advancing the financial stability of the undertaking. Lord Welby proceeded to state that the estimates for the new year showed that the southern system account just about balanced, but

that was after providing only £15,000 for renewals reserve. Better results were promised when the first portion of the new generating station at Greenwich was opened in the spring of next year, as the Council would then be supplying current from Greenwich at a much cheaper price, than that at which it was now being furnished as a temporary measure, by certain companies. This led the noble lord to refer to the proposed purchase as on March 31st, 1906, of the remainder of the lease granted by the Council to the North Metropolitan Tramways Co. The purchase was intended to be followed by the immediate electrification of the whole of the northern system at a cost, including all expenses incidental thereto, of from £4,000,000 to £5,000,000. During the time of reconstruction, which was expected to extend over some four years, there would necessarily be a considerable loss in receipts owing to the disorganisation of the traffic, and, moreover, the tramways undertaking would have to bear the interest and sinking fund charges on unremunerative capital of large amount. In these circumstances, notwithstanding the improved results expected to follow the opening of the Greenwich station, it could not be expected that the undertaking as a whole would do much more than preserve equilibrium between revenue and expenditure, including debt charges. During the six years up to March 31st, 1903, the total amount carried to the relief of the county rate was £293,592, or an average of £48,932 a year. During the period of reconstruction, the ratepayers might not unreasonably be content to forego any contribution in aid of the rates. The total outlay of the Council upon the purchase and reconstruction of existing tramways and the construction of new tramways would, in a few years' time, have reached a total of £11,000,000 or £12,000,000. The ratepayers would have lent their credit for the raising of this large sum of money, although the tramway undertaking had not cost the ratepayers a sixpence. Lord Welby thought, therefore, that the ratepayers should, when the undertaking had emerged from the period of reconstruction, receive consideration, and that it ought to be consistent with the financial stability of the undertaking to contribute a certain sum annually in relief of the rates.

The estimates submitted by the Highways Committee show a total income for 1905-6, of £810,831, from both the southern and northern tramways, and an expenditure of £786,148, leaving a balance of £24,683 at the end of the year. In the course of explanatory notes, the Committee stated that the results of the past year, revised in the light of over ten months of actual working, were expected to show, taking the horse and electric lines together, an improvement of more than £35,000 over the original estimate for 1904-5—horse lines £11,000 and electric lines £24,000. It was proposed to utilise the amount as follows:—(1) £13,085 to provide for the liquidation of the whole of the wastage on the establishment of the temporary power stations, which had not been already provided for, instead of leaving a further sum to be met out of the revenue for 1905-6; (2) £16,742 to increase the transfer to the renewals reserve account from £18,258 to £35,000; and (3) the balance to the appropriation account towards meeting general tramway expenditure. As far as the estimates for the new year are concerned, the Committee pointed out that these were based for electric traction on the assumption that the average number of cars in operation would be 321, each running on the average not less than 96 miles daily; that the receipts would average 11·8d. per car-mile, and that the working expenses, before paying interest and repayment charges, and without making any provision for renewals, would be about 8d. per car-mile run. It was expected that this rate would be reduced to 7d. per mile when power was obtained from the Greenwich station. The total receipts for electric traction was estimated at £566,920, and the total working expenses at £381,860. After setting aside £15,000 as renewals reserve, there would remain a balance of £170,060, which after deducting the estimated deficiency of £160 on horse traction, and providing for interest and repayment of debt and income-tax on profits, would leave a small balance of £143 to be carried to the appropriation account. As far as relates to the northern tramways, the Committee expected a surplus of £23,209 after providing for debt charges. The amount carried to the relief of rates from the tramways account since the commencement had reached a total of £293,592, while the total debt repaid amounted to £335,237.

The adjourned report of the Highways Committee was submitted in reference to the proposed expenditure of £121,000 for the acquisition of the Northern Tramways lease and the payment of £315,000 for the purchase of the company's rolling stock, plant, &c., as reported a few weeks ago. An amendment was proposed that it was inexpedient to purchase the lease and proceed with the proposed conversion to electric traction pending the issue of the report of the Royal Commission on London Locomotion. On a division the amendment was rejected by 74 votes to 21, and on a further division the recommendation of the Committee was carried by 68 votes to 20, deciding to take over the North Metropolitan Co.'s lease and property as from April 1st, 1906.

The Highways Committee sought authority to expend £2,500 on the purchase of four electrically-driven watering cars.

Maidstone.—The Light Railway Commissioners have submitted to the B. of T. for confirmation, the application of the T.C. for an order for extending the electric tramways to neighbouring places outside the borough.

Paris Metropolitan Railway.—The gross profit of the Metropolitan Electric Railway Co., of Paris, in 1904, amounted to £830,000, as compared with £711,000 in the preceding year, when the mileage in operation was slightly less. After meeting working expenses and paying to the Paris Municipal Council its share of the profits—namely, £266,900, as against £227,740 in 1903—there remains a balance of £213,448, as contrasted with £200,000. It is proposed to appropriate £160,000 for the payment of a dividend of 16s. per share on the old 200,000 shares. The total share capital of the company is £3,000,000, and it is now possible to make an issue of bonds to provide for the equipment of further extensions of the railway.

St. Helens.—More than a week has elapsed without communication being exchanged between the directors of the St. Helens Tramway Company and the former employés, who are now on strike with no prospect of an early settlement. Between 10 and 11 o'clock on Friday night, stones were hurled through windows of two of the cars on Eccleston Hill, whilst making the inward journey from Prescot to St. Helens. There were passengers in the cars at the time, who fortunately escaped injury. Friday was the first occasion on which the cars had been run after dark since a similar incident occurred at the commencement of the strike.

On Friday one of the strikers was charged with assaulting James Lowe, one of the present drivers. He was fined 5s. and costs or seven days, and bound over to be of good behaviour for three months. On Monday morning a glass packer was also charged with a breach of the peace. He had to be locked up, and he was now ordered to find sureties for six months or go to gaol for seven days. Other actions are pending, and the police are kept busy protecting the cars on the Prescot section.

There is every evidence of a long and determined stand being made by the strikers, and at present there is no sign of a rapprochement. The company is training new drivers and conductors.

South African Notes.—KIMBERLEY.—The formal opening of the electric tramway to Alexandersfontein took place the other afternoon in the presence of Sir Lewis Michell, the Mayors of Kimberley and Johannesburg, the local Members of Parliament and the Town Councillors. The undertaking has been carried out by De Beers for the benefit of the town.

Wednesbury.—The T.C. has arranged to purchase the undertaking of the South Staffordshire Tramways (Lessee) Co. for £28,920, and for this purpose a loan of £29,000 has been applied for.

A special meeting of the T.C. is to be convened to consider the matter, and at the meeting a resolution will be submitted to the effect that the seal of the Corporation be fixed to a conveyance for the sale to the Tramway Co. of the site of the depôt, workshops, and offices, together with the buildings thereon, and the plant, &c., for £11,500, and on the completion of the sale the proposed loan will be proportionately reduced. One result of the settlement is likely to be an early resumption of the tramway service between Wednesbury and Darlaston.

Widnes and Runcorn Transporter Bridge.—This remarkable structure, which spans the River Mersey not far from the iron bridge of the London and North-Western Railway, is now completed, and will be opened for traffic at the beginning of June. It is designed for the transport of heavy traffic across the river. The car consists of a platform 55 ft. × 24 ft.—large enough to hold four 2-horse wagons, loaded, and 300 passengers. The bottom of the car is 12 ft. above high-water level, and it clears the Ship Canal wall by 4 ft. 6 in. The motive power is electricity. The car is suspended by steel wire ropes from a trolley 77 ft. long, which runs upon rails on the underside of the girders of the bridge. The trolley is carried by 16 wheels on each rail, and is propelled by two electric motors of about 35 H.P. each, the electricity being generated by a 70 H.P. gas engine on the Widnes side. The car can be brought up within its own length when travelling at full speed. The regulation time for transit from one side of the river to the other is 2¼ minutes. The work has been undertaken and completed by the Widnes and Runcorn Transporter Bridge Co., Ltd., whose chief engineer is Mr. J. J. Webster, of Liverpool. Some recent trials have proved the working of the bridge to be entirely satisfactory.

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1)	Aug. 26, 1901	
Trinidad-Demerara (No. 2)	May 11, 1905	
St. Lucia-Martinique	May 7, 1902	
Dominica-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 23, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed Vladivostok-Nagasaki	Feb. 9, 1904	
Closed Port Arthur-Chifu	Mar. 9, 1904	
Jamaica-Colon	Jan. 5, 1905	
Bathurst-Bissao	April 22, 1905	
Cape Haite-Mole St. Nicholas	April 28, 1905	
San Domingo-Curacao	May 5, 1905	
Bonny-Duala	May 12, 1905	
Dakar-Conakry	May 11, 1905	
Landlines.		
Puerto-Barrios	July 28, 1902	
Kertch-Soutchoum	Sept. 27, 1904	

Canada.—The *Standard* Ottawa correspondent states that a Bill incorporating the Fessenden Wireless Telegraph Co., of Canada, has passed the Railway Committee. The Minister of Marine said an arrangement had been made with the British Government to pass a general law regulating wireless telegraph systems.

Australian Telephone Rates.—The Queensland electrical officer, Mr. Hesketh, who recently toured the United States and Europe, has submitted to the Postmaster-General his report on the results of his observations of the telephone systems in the European countries. Mr. Hesketh suggests that in Australia the toll system should be inaugurated by refusing subscribers at the present rates from January 1st next, and introducing a scale of charges based on the size of the network and the calls on the line. He recommends a rate of £1 for every 500 additional calls, or, say, ½d. per call over the number covered by the annual subscription. He argues that the present Australian rates are far too low for an unlimited service, and suggests for a service with 600 calls a year free within 1 mile from the exchange the following rates, which would, under proper commercial management, he says, be remunerative even in the largest Australian centres:—

Separate line, £7 a year.
Two-party lines, each party £5.
Four-party lines, each party £3 10s.

Assuming that 15 calls are made on each working day, or 4,600 a year, a fixed annual charge on the measured basis should not be less than:—

Separate line and 600 calls, £7.
4,000 extra calls at £1 per 500, £8; total, £15.

This is equivalent to saying that if a large user guarantees to operate the line 15 times a day, he is given free as many more calls as he cares to have. The greater proportion of the telephone users of the future will, Mr. Hesketh thinks, be those who utilise the instrument from three to five times a day. Any new scheme should be drafted for this large majority of the hitherto unreached public.

Cardiff Telephones.—A new telephone exchange, constructed on the common battery system, has been installed at the Cardiff Post Office, and will shortly be opened for use.

Continental Notes.—ITALY.—Negotiations are reported to be in hand with regard to the establishment of international telephonic communication between Milan and Geneva, Switzerland.

Houghton-le-Spring.—Apprehension having been felt by the Postal authorities at the proximity to the telegraph wires of the overhead cables erected by the Sunderland District Tramways Co., they asked leave of the U.D.C. to shift the poles and wires to the other side of the road, but consent was refused, the Council urging that the poles should be erected on private land. To this the Postal authorities demurred, stating that the revenue from the local telegraph service would not justify the expense which would be involved. As no agreement has been come to, the telegraph service has been suspended.

Mexico.—The Mexican Telegraph Department has placed a contract with an American firm for a submarine telegraph cable, to connect the island of Carmen with the mainland.

Portsmouth Telephone Inquiry.—We referred in our last issue to the questions raised by the Inspector at this L.G.B. inquiry in regard to the raising of a loan to carry out work that the L.G.B. had refused to sanction. The *Portsmouth Evening News* says that the deputy town clerk, Mr. Etherton, urged that the balance of the revenue account would about equal that on the suspense account, which, it was explained, was constituted for the repayment of the overdraft. The amount expended over and above that sanctioned by the L.G.B. was £3,114, which was borrowed from the Finance Committee.

The Inspector: The Board felt that the ratepayers' money should not be expended in certain works which the Council proposed to do, but the Council have apparently overridden the decision of the Board and proceeded to carry out the works. In what position do we stand in regard to this inquiry? If the L.G.B. refuse to sanction this loan is the Council going ahead, and the ratepayers have practically no representation at all?

Mr. Etherton: I cannot say what the Council will do. The last work was practically in hand, and the Council considered that it was either a question of going on with the work or that it must come to a standstill, and they chose the better alternative.

The Inspector: There is no question that in this matter the Council have gone quite outside their statutory powers.

The Inspector questioned closely as to the limitations of the "suspense account," which he declared appeared to him unlimited. This, however, was denied.

Mr. Robb drew attention to the fact that the Telephone Committee and the Finance Committee were practically synonymous, as 10 members were sitting on each, and it practically meant one Committee lending itself the money. "It is," commented Mr. Robb, "very illuminating as to the methods of the Council."

Mr. Etherton urged that the matter was confirmed by the Council unanimously.

The Inspector: Has any work in respect of this loan been anticipated?

Mr. Etherton: Yes, sir.

After further questions as to the accounts, the Inspector remarked that on January 25th the over expended capital was £3,114, and on March 31st the suspense account was £4,137 17s. 4d. Also on the same date there was a sum of £1,637 which was allocated against the present application, and therefore was no part of the £4,137. He also referred to a letter received from the Council by the Board on April 14th, an estimate for works which had been carried out seven weeks before, which he contended was a very unfair representation.

Swansea.—The balance-sheet of the telephone department shows a net credit balance of £415, which, added to a similar balance of £324 brought forward from last year, shows a financial profit of £739 up to March. Altogether £22,532 has been expended on the undertaking, and the total revenue from all sources last year was £3,963.

Telephone Purchase.—Fears have been expressed that the report of the Select Committee on the Telephone Agreement, which is to be nominated on Monday next, will not be before the House of Commons in time for discussion this Session, so that according to the terms of the agreement the latter, it is alleged, will automatically become binding on August 31st. Lord Stanley has stated that he sees no reason to doubt that the time allowed for consideration of the question will be sufficient.

The Dutch Cable in the East.—A telegraph station for international service has now been opened at Jap in the Carolines, the station being connected by means of a cable, which belongs to the German—Netherlands Telegraph Co., with Menado (Celebes) on the one hand and Guam on the other. The laying of the Menado—Jap—Guam section was completed on April 26th by the North German Marine Cable Works Co., of Cologne and Nordenham, the work being performed by the cable steamer *Stephan*. The total length of the cable is 1,884 miles, and the maximum depth to which it has been laid is approximately 4½ miles. By means of this cable the Netherlands Indian Colonies and the German Caroline Islands have been brought into connection with the American Pacific cable. The *Stephan* has now proceeded to Shanghai for the purpose of laying the coast section, which is 130 miles long, of the cable which will form part of the cable between Shanghai and Jap. This main section of the cable is being manufactured at Nordenham, and is to be laid in the ensuing winter. The rates for telegrams to Jap amount to 5s. per word *vid* Emden—Vigo—Madras—Menado, or *vid* Bushire—Madras—Menado, or by the Eastern Telegraph Co.'s cable, Madras—Menado.

Underground Telegraphs. — The Association of Chambers of Commerce of the United Kingdom recently forwarded to the Postmaster-General a memorial urging the importance, in the interests of trade and commerce, of all trunk telegraphic wires being laid underground, so as to obviate the delays which are at present frequently caused by storms breaking down the overhead wires. The Postmaster-General replied that last year £150,000 was spent on the underground line to the north; and with the assent of the Treasury he had included the same amount in the Estimates for the current financial year. With that amount he would be able to complete the underground line from London to Glasgow and to begin underground lines to the east and to the west from London.

The following answer by the Postmaster-General to a question by Sir Thomas Dewar was on the Parliamentary papers on Wednesday (May 17th): "The cable is complete as far as Carlisle, the pipes are all laid between Carlisle and Glasgow; and the cable for these pipes has been ordered, and will be drawn in during the present year. The underground line from London to Glasgow will then be complete."

Wireless Telegraphy between Berlin and Dresden.—An installation between these two cities has now been established and is in regular operation, solely, at first, for the purpose of experiments on the part of the Berlin Company for Wireless Telegraphy. The object of the trials is to test apparatus which aims at securing certain transmission over such a distance as separates the two cities and the intervening country, as telegraphy overland is said to require from two to three times the power necessary for the same distance over the sea. In Berlin the station is situated at the Oberspree electricity works, in Ober-Schöneweide, where only a transmitter is installed, while the Dresden station, which is located at the Technical High School, is only equipped with receiving apparatus. There is no question of establishing a public service of wireless messages between the two capitals. A deputation of Bulgarian engineers and high officials has visited Berlin in order to investigate the station and the working of the system.

The Composition of the Arc Light.—Special measurements made by J. Precht and E. Stenger show that as the consumption of power in an arc light increases, the amount of blue light increases out of proportion to the increase of the green and red rays. This is in accordance with theory, because the greater consumption of power connotes a higher temperature, and this involves the emission of a larger proportion of light of short wave-lengths.

Electrodes of Iron Oxide.—A Swedish patent has been taken out by E. W. Jungner, of Norrköping, for a process of making electrodes mainly composed of ferric oxide, which are claimed to possess a high degree of activity. Plates of iron are heated to a white heat in presence of air, and in contact with a carbonaceous fuel. As soon as they have become incandescent, they are plunged into cold water, when the layers of oxides mixed with carbon which have formed on the surface of the plates, scale off. These are dried and powdered, mixed with lead ore and crystalline graphite, made into a paste with water, and finally baked.

THE HYDRO-ELECTRIC INSTALLATION OF TURBIGO, LOMBARDY.

By ENRICO BIGNAMI.

Two years ago (ELECTRICAL REVIEW, July 24th, 1903) we published a description of the great hydro-electric generating station of Vizzola, on the Ticino—one of the largest installations of its kind not only in Italy, but in Europe—which was erected and equipped by the Società Lombarda per Distribuzione di Energia Elettrica. This plant distributes electrical energy to the surrounding districts, which correspond in character to our Lancashire and Yorkshire, and constitute the chief industrial areas of Italy; the installation at first developed 14,000 H.P., but was afterwards increased to 19,000 H.P. Nevertheless, the company has found it necessary to provide for still greater demands, and has, therefore, laid down a new installation at Turbigo. The latter has now been completed, and operates in parallel with the plant at Vizzola.

FIG. 1.—INTAKE FROM THE NAVIGLIO GRANDE.

The new installation, like its forerunner, is energised by a by-pass from the River Ticino, the Naviglio Grande—noteworthy as being the first canal to be cut in Upper Italy, its construction having been commenced as far back as the year 1179. The waters of the latter are diverted from it in the Castellana region into a new canal, 5,590 m. in length, which runs alongside the Naviglio Grande for three-quarters of its length; the available head is 8·2 m., which gives, at the rate of flow permitted by the terms of the concession—namely, 62 m.^{3} per second—a total power of 6,800 H.P., corresponding to about 5,400 B.H.P. on the turbine shafts.

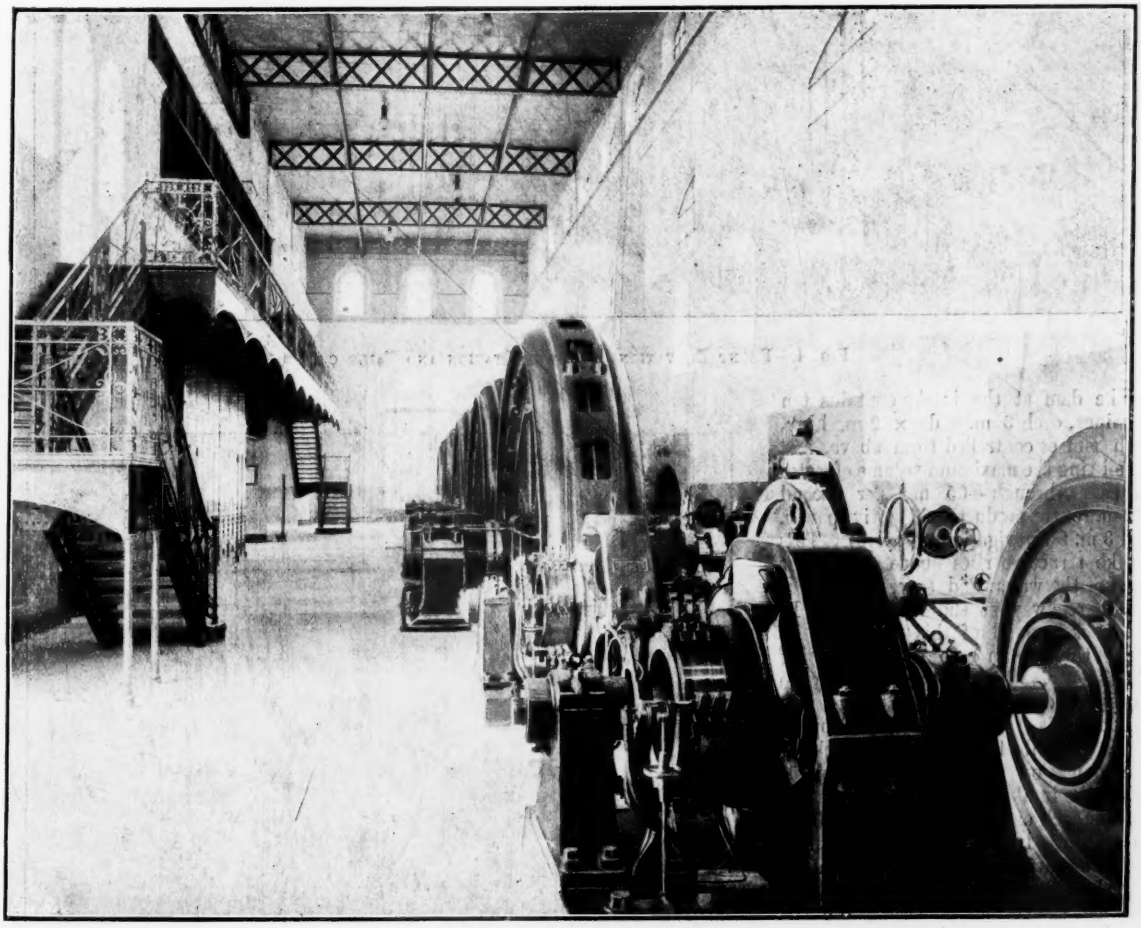


FIG. 2.—INTERIOR OF TURBIGO POWER STATION.

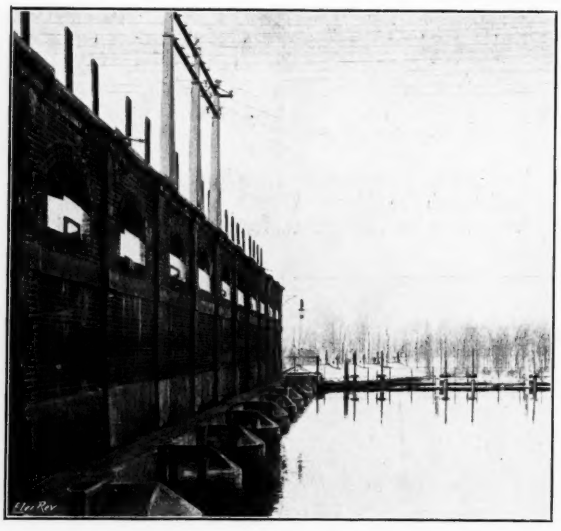


Fig. 3.—Forebay at Turbigo.

height of 2·75 m. above the floor of the Naviglio proper and consists of two iron frames situated at a distance of 1·2 m. apart, turning on hinges at the foot, and carrying the foot-bridge giving access to the working of the battens. This construction was adopted in preference to that of a simple earthen dam, such as had been arranged for in the original project, on account of the intention of preserving the old Naviglio as a stand-by to the new canal, so as to ensure the continuity of the irrigation in the event of any untoward accident.

As above stated, the canal has a total length, from the intake to the power station, of 5,590 m. From the latter the water is discharged directly into the Naviglio, restored in the neighbourhood of the bridge of Turbigo over a length of 500 m.

The power station buildings are situated at the end of the canal, on the left bank of the Naviglio. They consist of two parts: the first, facing the upper canal and in direct communication with the forebay formed at the end of the said canal, is destined exclusively for the turbines, each of which is fixed at the bottom of a separate basin, open to the sky; the second adjoins the first, and consists of a large room, 40 m. long × 10 m. wide and 12 m. high, and some smaller rooms for operating purposes, and is devoted entirely to the electrical machinery.

Fig. 4.—Front Elevation of Power Station and Tailrace.

The dam at the intake contains ten openings, each 3 m. wide × 2 m. high, with sluices controlled from above, and permitting the maximum volume of water to pass through—65 $m.^3$ per second (62 m. for the production of motive power, and 3 m. for navigation purposes). This intake structure rises above the highest level of the water, and serves to carry a public roadway, as shown in fig. 1. In the back ground of this view may be seen the steam power station of Tornavento, which supplies energy to work the electric railways running into Milan; this station was described in our issue of April 24th, 1903. The lock for the navigation of the canal is situated below the intake works, at the mouth of an approach channel more than 150 m. in length. Its dimensions are those which are nowadays required by statute, namely, 38 m. in length and 5·5 m. in width at the bottom, increasing to 6·5 m. at the top. The lock gates are of the wooden door type which has been handed down to us from time immemorial.

A movable weir serves to shut off the old canal and to guide its waters into the new channel. The weir rises to a

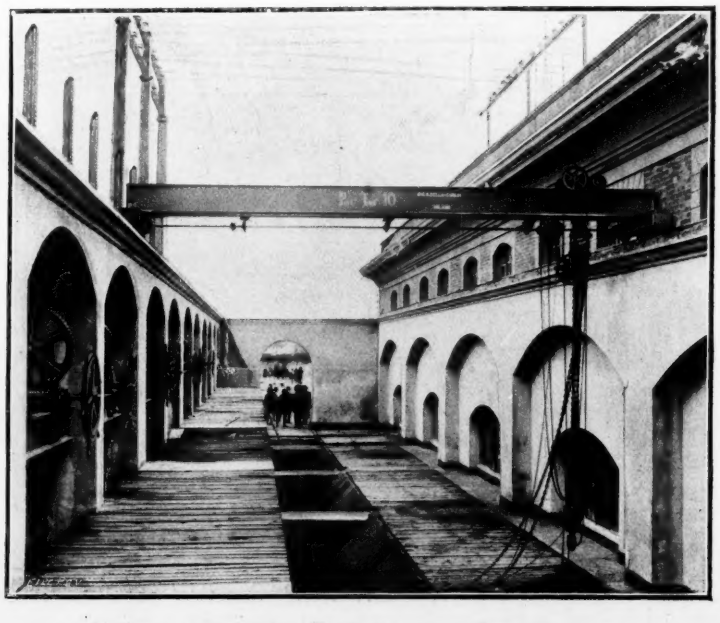


Fig. 5.—Sluice Gear for Controlling Turbines.

The hydraulic works at the power station consists of weirs, spillway canal, &c., which are situated on the left bank of the principal canal bringing the water to the power station, and in close proximity to the latter.

As it is necessary to maintain the water in the discharge canal always at a constant level, in order to avoid variations in the rate of flow of the waters, which are diverted at intervals along the length of the Naviglio for irrigation purposes, by gates of fixed capacity, three outlets have been made, in addition to a spillway 90 m. long, at the bottom of the left wall of the forebay above the turbines. These are furnished with control gates automatically operated by electrical means, continuously depending upon the slight variations of level in the basin itself.

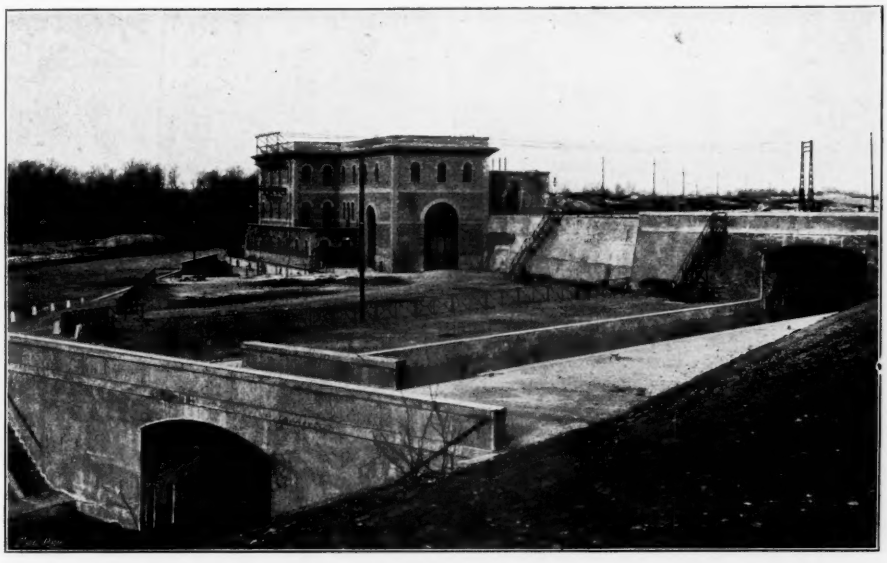


Fig. 6.—Turbigo Power Station, showing Spillway Canal and Transmission Line.

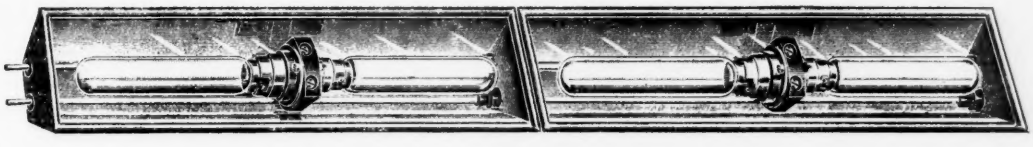
In order to ensure the continuity of the working of the installation at the time of the annual draining of the Naviglio, and, further, to discharge without interruption the excess of capacity provided by the new canal (which is lined with an impermeable coating, doing away with the leakage and absorption of the old bed of the Naviglio), on the left bank of the latter, and almost opposite the power station, there has been constructed a discharge aqueduct with 23 m. clear opening divided between six gates, from which a canal 587 m. long leads to the Ticino, capable of returning to the latter the whole discharge of the new works.

The generating plant comprises five electric generators, all of the same size; four of these are normally run, and the fifth is held in reserve. Each set consists of a turbine with horizontal shaft, with an output of 1,500 B.H.P., coupled directly and rigidly to a three-phase alternator of corresponding capacity. There are two small auxiliary groups for the excitation of the main generators, and to supply power for lighting, driving cranes and the machine tools in the repair shops; each of these consists of a turbine with horizontal shaft, of 100 B.H.P., connected by a flexible coupling to a direct-current generator.

The station is also provided with an overhead electric travelling crane of 25 tons capacity, and with switchboards and electrical apparatus for the control of the generators and the outgoing feeders.

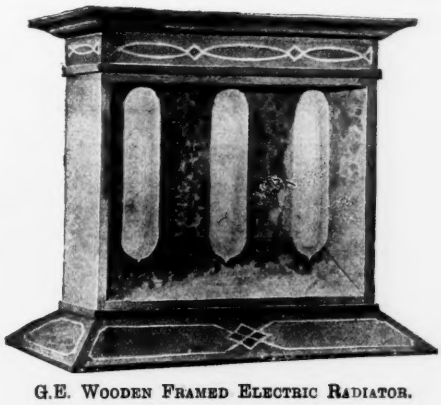
For the admission of water to the turbines from the forebay, there are corresponding to each turbine a pair of gates separated by a sheet-iron partition, and having each an opening of 3 m. × 3·20 m., with regulating gear operated by hand. In front of each gate there is a grating having an opening of 6·5 m.

The three-phase alternators are of the rotating field-magnet type, with separate poles; the armature is wound with removable coils, shaped upon special formers. Each alternator is built for a normal output of 1,320 kilovolt-amperes, corresponding with an output of 1,050 KW. on an inductive load, having a power factor of 80 per cent. at the normal pressure of 11,000 volts and a frequency of 50 cycles per second. The bulk of the power developed by the installation at Turbigo, amounting to about 3,500 KW., will be transmitted over three overhead lines, and distributed mainly in the area which is also served by the Vizzola generating station, especially in the neighbourhood of Legnano, where the greater portion of the consumers are situated. The remainder of the power of Turbigo, amounting to about 1,000 KW., will be distributed to new factories engaged in the cotton industry in the region between Saronno and Rho.



The M.I.P. Patent Reflectors for Electric Lighting (See Page 815).

With the completion of this installation at Turbigo, the Società Lombarda has initiated the work of organising and setting upon a new basis, the navigation of this ancient waterway, upon which for many years a feeble and tedious traffic has languished. At present there only remains the organisation of the length of about 22 km. between the new station at Turbigo and the Bridge of Abbiategrasso, upon which the excess of gradient will give,



G.E. Wooden Framed Electric Radiator.

with a single fall of 11 m., a power of 4,500 B.H.P. at a distance of only 20 km. from Milan.

Riva, Monneret & Co., of Milan, which is well known on account of the immense turbines which it has exported to

Fig. 1. Fig. 2. Fig. 3. Fig. 4.

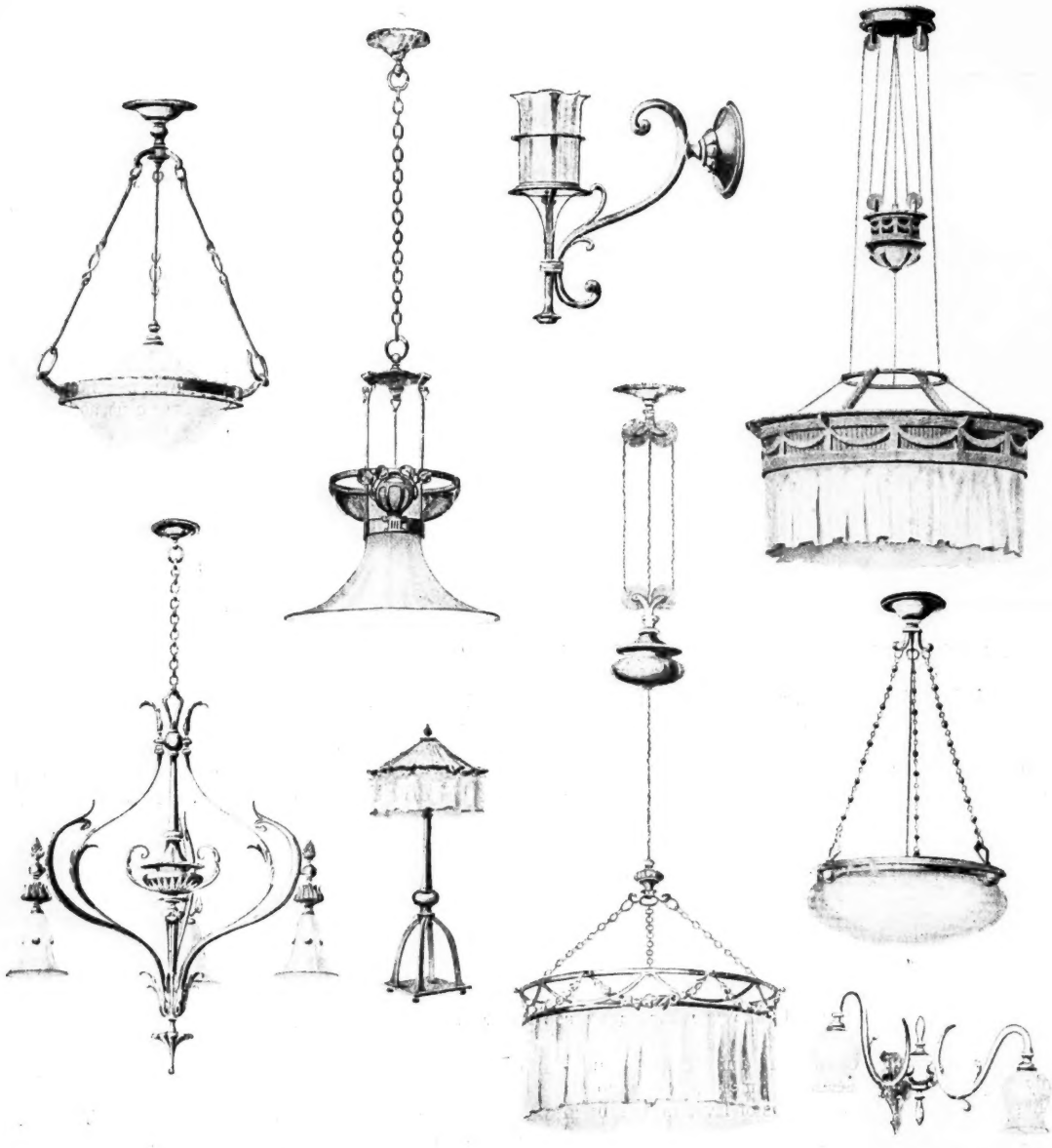


Fig. 5. Fig. 6. Fig. 7. Figs. 8 and 9.

New Electric Light Fittings.

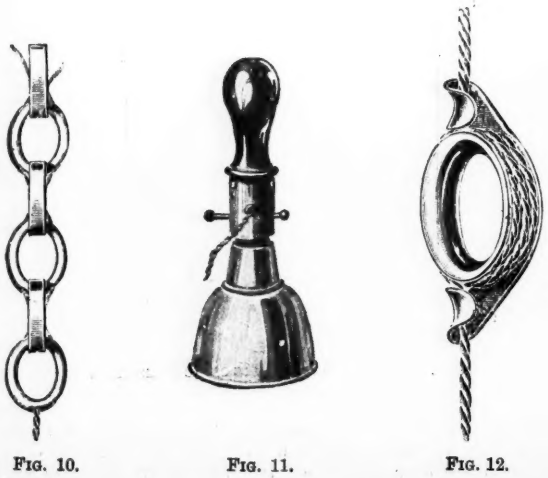


Fig. 10. Fig. 11. Fig. 12.

The turbines of this installation, with the automatic oil-regulators connected therewith, were supplied by the firm of other European countries and the United States. The alternators, together with all their accessory apparatus, were furnished by Messrs. Gadda & Co. and Brioschi Finzi & Co., also of Milan, who have been able to carry out electrical installations on the largest scale, in competition with foreign firms, and have hitherto held a prominent position in Italy in the construction of the most important undertakings.

With reference to the progress of these national industries, it is worthy of note that Italian capital has almost wholly replaced foreign capital, not only in connection with the enterprises already accomplished, but also in the formation of new companies and installations for the exploitation of the natural sources of power of the country, a fountain of wealth which is continually acquiring increased importance and value.

NEW ELECTRIC LIGHT FITTINGS.

Manufacturers of electric light fittings are continually engaged upon the production of new designs. No sooner are one season's styles before the trade and the public than the designing specialist's department must set to work upon something new, and if possible, better, to meet, or perhaps to make, the tastes which will prevail in

the next. We have been through a good many fittings showrooms in our time, and have noted the interesting changes that have taken place from season to season, in designs, in metals employed, and the ever-increasing zeal evidenced in the efforts to produce fittings to meet the needs and tastes of users of electric light in every station in life, from the delicate refinements in request for the luxuriously furnished country-house or Park Lane mansion to the plainness and cheapness required for the workmen's dwellings, say, of West Ham. At times the new designs strike one as being merely a reversion to old types with a slight touch of the modern about them; some being the revival of the old massive splendours that our grandfathers used to employ for candle lighting. There are exact copies of fine old specimens of French art fittings of 100 years and more ago, for those to whom artistic accuracy is of greater moment than economy of cost; for those of thinner purse there are less expensive, because less accurate, copies of the same old designs.

We might write a good deal more in a similar strain to the foregoing, for we have just had the pleasure of a visit to the excellent fittings showrooms of the General Electric Co., Ltd., in company with two of their specialists in that department, with a copy of their new Electrical Fixtures and Glassware Catalogue as a sort of guide. Our difficulty is to know which objects to mention and which to omit from this notice of our visit, for there is such a host of things new and interesting; we must leave it to the accompanying illustrations of selected representative types to make up for anything that our pen may lack.

Two new departments have just been fitted up at 67, Queen Victoria Street, E.C., for the effective display of crystal fittings, which are now more in demand again, and for exhibiting a fine collection of accurate classic French designs which also are specially in request. As we have already indicated, cheaper and less correct copies of the same designs are also on show. In wooden electric light fittings, too, the company has launched out, having adopted a special patented fire-resisting wood expressly for this purpose; the wooden-framed radiator which appears among the accompanying illustrations is noteworthy among the new things in this collection. Both in its catalogue and in its showrooms the G.E. Co. has almost every recent kind of bracket, pendant, electrolier, ceiling light, standard, bronze, and so on, that the heart could wish for. They are finished in polished or antique brass, steel and Florentine bronze, or bronzed and relieved, oxidised copper and silver, silver-plated and real gilt. Large stocks are kept at the London and provincial showrooms, and at the Birmingham factories over 600 workmen are continuously engaged solely in the production of the fittings and accessories shown in the newly-issued catalogue.

We must pass hurriedly over the variety of small accessories, ball and counterweight fittings, shop window and picture reflectors, water-tight pendants, &c., though mention ought to be made of some special fittings which are shown for tramcar and train lighting, and also of the plain iron fittings for the lighting of hospitals and asylums and other public buildings. Our fig. 1 is a specimen of one-light ceiling fixture in polished brass (known as the "Stourport"), and fig. 8 shows the Stratton open-roofed fitting for one to three lights; fig. 2 is a brass pendant of pleasing appearance (the "Denstone"), finished in oxidised copper with enamelled medallions; the "Bootle" bracket and lantern is seen in fig. 3. In figs. 4 and 6, as will be easily observed, are some fine examples from the wooden fittings section. The "Ludlow" three-light electrolier, cast and chased, is shown in fig. 5, and in fig. 7 there is illustrated the "Tidworth" open top electrolier, which is of a dull gold colour, with cast and chased metal work and a silk flounce. Fig. 9 represents a polished brass two-light bracket, the "Gillingham."

A new feature for dressing table mirror lighting is an adjustable fitting, the arm of which by means of a sliding ball arrangement can be placed at any desired height, the arm being also lengthened or shortened, as may be required, by a screw. A small but very useful device is the ward hand lamp, shown in fig. 11. We understand that, in addition to the 16-C.P. Robertson lamp for general use in this device, one of smaller power is fixed in the handle for use at night time, so that patients may not be needlessly disturbed. The handle is of wood with asbestos lining, and there is a resistance in the handle in circuit with the illuminating lamp. The patent oval-link chain shown in fig. 10 is employed for many G.E.C. fittings, and it effectually hides the cord in a very simple manner. A new patent cord shortener appears in fig. 12.

We have only space to refer to one more speciality shown in this excellent catalogue—the "M.I.P." patent reflectors for shop cornice and picture lighting. These reflectors are made in 12-in. sections, which are interchangeable with each other, and can thus be coupled together for any reasonable length, making a continuous reflector. No wiring is needed, as the lamps, which can be of ordinary stock types, are attached to insulated rods carrying the current. These rods terminate in plugs and sockets. We show two of the sections coupled up, on page 814.

CONTRACTS OPEN AND CLOSED.

OPEN.

Ashton-under-Lyne.—May 23rd. Six single-deck tramcars. See "Official Notices" May 5th.

Bangour Village.—May 27th. Edinburgh District Lunacy Board wants offers for boilers, engines and dynamos, economisers, cranes, battery, switchboard, cables. Electrical engineers, Messrs. Buchan and Hogarth, 16, Rutland Square, Edinburgh. Architect, Mr. H. J. Blanc, 25, Rutland Square, Edinburgh.

Bracebridge Asylum.—June 7th. Fire alarms, telephones, bells, and tell-tale clocks, for this Asylum. See "Official Notices" to-day.

Brecon and Radnor Asylum.—June 7th. Wiring and motors for the new farm buildings, also fire alarm installation at the Asylum. See "Official Notices" to-day.

Bristol.—The City electrical engineer is inviting tenders for single-phase alternating-current transformers and three-phase to direct-current motor-generators.

Burslem.—May 30th. The Corporation invites tenders for wiring the Town Hall, Markets, &c., also for house service fuses and meters. Mr. Ashton Bremner, borough electrical engineer.

Clydebank.—May 22nd. Electric arc light installation for the Outer Basin of Clydebank Dock. Mr. Geo. H. Baxter, mechanical engineer, Clyde Navigation, 16, Robertson Street, Glasgow.

Croydon.—Three direct-coupled single-phase motor-driven centrifugal pumping sets for the Corporation Sewerage Works. See "Official Notices" to-day.

Darlington.—May 23rd. Two storage batteries for the electricity works. See "Official Notices" May 12th.

Dartford.—May 24th. Lancashire boiler, piping, one 200 KW. steam dynamo, traction battery and reversible booster, main switchboards, &c., for the U.D.C. light railways. See "Official Notices" May 5th.

Dublin.—May 30th. The Cleansing Committee wants tenders for tank wagons, covered tipping wagons, &c., for conveying city refuse over the tramway routes. City engineer, Mr. Spencer Harty, City Hall.

Edinburgh.—May 30th. Switchboard panel extension for McDonald Road station. See "Official Notices" May 12th.

Edinburgh.—June 6th. Steam and exhaust pipe-work for the McDonald Road electricity station. See "Official Notices" to-day.

Glasgow.—May 22nd. Electric light installation for the Parkhead District Library. Specifications from Mr. J. R. Rhind, 67, Hope Street, Glasgow.

Islington.—May 24th. Coal bunkers for the electricity works. See "Official Notices" May 5th.

Keighley.—May 20th. Superheaters. See "Official Notices" May 5th.

Kettering.—May 29th. Nernst lamps, posts, &c., for street lighting. See "Official Notices" May 5th.

Llandudno.—May 22nd. Switchboard extensions, also two balancing sets for the U.D.C. See "Official Notices" May 12th.

Melbourne.—July 14th. Arc lamps, poles, brackets, &c., for street lighting for the Council. See "Official Notices" May 12th.

Partick.—June 6th. Water-tube boiler, switchboard extensions, coal conveyor, bunkers, feeder cable, &c. See "Official Notices" to-day.

Radcliffe.—May 30th. One 250-KW. steam dynamo for electricity works extensions. See "Official Notices" to-day.

Spain.—June 4th. The Spanish Ministry of Posts and Telegraphs in Madrid is inviting tenders, until June 4th, for the supply of 50 tons of galvanised iron telegraph wire, 4 mm. diameter and 5 tons of bronze wire, 3 mm. diameter. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegraphos, Carretas, 3, Madrid.

St. Pancras.—May 23rd. Arc lamp carbons for one year. See "Official Notices" May 12th.

Sunderland.—May 24th. Tramway stores. See "Official Notices" May 5th.

Swansea.—June 5th. Two motor-alternators for the Corporation. See "Official Notices" to-day.

CLOSED.

Bolton.—The Electricity Committee has accepted the tender of Messrs. Musgrave & Sons, of Bolton, for the supply of condensing plant.

Burslem.—The T.C. has accepted the tender of the Glasgow Patents Co, Ltd., for the supply of a water softener to the electric lighting works, at £362.

Bury.—Messrs. Ashworth & Parker, of Bury, have secured the order for the generating plant for the electric light installation at the new Workhouse Hospital.

Cumberland.—The West Cumberland Power and Tramway Co., Ltd., has accepted the tender of Messrs. R. W. Alpine and Sons, of Glasgow, for constructing the permanent way of the West Cumberland Tramways, and that of the Brush Electrical Engineering Co., Ltd., for the machinery.

Glasgow.—The Electricity Committee has recommended to the T.C. for acceptance the following offers in connection with Port Dundas and Pollockshaws Road stations:—

Babcock & Wilcox, Ltd., coal and ash conveyors, £5,181.
British Electric Plant Co., Ltd., Alloa, feed-pumps, motors and accessories, £920 5s.
Mirrlees-Watson Co., Ltd., condensing plant, £1,250.
British Westinghouse Co., Ltd., motor-generators, £5,610.
Messrs. Ferranti, Ltd., switchboards, £851.

The General Electric Co, Ltd., has secured the contract for supplying the Corporation Cleansing Department with carbons for one year.

The Electricity Committee of the Corporation has recommended for acceptance the following offers for stores for a period of one year:—

Messrs. W. T. Glover & Co., Ltd., for high-tension cable; Callender's Cable and Construction Co., Ltd., for low-tension cable; Messrs. W. T. Glover & Co., Ltd., for india-rubber-covered conductors, cables and wires; Messrs. Ferranti, Ltd., for meters; Messrs. Chamberlain & Hookham, Ltd., for meters; Messrs. Crompton & Co., Ltd., for carbons; the Sloan Electrical Co., Ltd., for carbons; the Scottish Wood Haskinising Co., Ltd., for wooden troughing; the Falkirk Iron Co. and the Alloa Iron Co., for cast-iron boxes in sections.

The whole of these offers, with the exception of those for the supply of meters, are, so far as regards the offerers who complied with the respective specifications, in each case the lowest.

Govan.—The following is a list of the successful tenderers for electricity department stores for the current year. There were 257 tenders sent in:—

1.	Engine and cylinder oil ..	John Macqueen & Co., Glasgow.
	Red & White Lead & graphite ..	" " "
	Packing & gauge glasses ..	Ferguson & Timpson "
	Sponge cloths, white & coloured waste	James Duncan, Govan.
2.	Cables	Brit. Ins. & Helsby Cables, Ltd.
3.	Cable accessories	" " "
4.	Bitumen and compound	Craig Sharp, Ltd., Glasgow.
5.	Meters up to and including 25 amperes	Ferranti, Ltd., Hollinwood.
	All sizes over 25 amperes ..	Chamberlain & Hookham, Birmingham.
6.	Fuse boxes	Keighley Electrical Eng. Co., Keighley.
7.	Wrought iron tubes and fittings	D. Richmond & Co., Govan.
8.	Cast-iron pipes	David King & Co., Glasgow.
9.	Cement	Scott & Rae, Glasgow.
10.	Brushes	W. Morier, Govan.
	All other items	P. & W. M'Lellan, Ltd., Glasgow.
11.	Paints and linseed oil	Jas. Storer & Co., Glasgow.
	All other items	Jas. Duncan, Govan.
12.	Timber	Robinson, Dunn & Co., Partick.
13.	Carbons	Crompton & Co., Ltd., London.
14.	Coal	John Kennedy & Sons, Glasgow.
15.	Joint boxes	Not yet settled.
16.	Motors 1, 2 and 3 H.P.	British Thomson-Houston Co., Rugby.
	All other sizes	Lancashire Dy. & Motor Co., Manchester.
17.	Motor starters (contract divided)	Reyrolle & Co., Hebburn-on-Tyne, Monté-Callow, London, Brook, Hirst & Co., Chester.
	D.P. switches	Berry, Skinner & Co., London.

Hammersmith.—The B.C. has received the following tenders:—

FOR SUB-STATION SWITCH-GEAR.

Ferranti, Ltd. (accepted)	£809 0
Brush Electrical Engineering Co.	890 0
Crompton & Co.	939 0
Cowans, Ltd.	1,004 10
General Electric Co.	1,114 0
British Thomson-Houston Co. (accepted for equipment for one sub-station, at £190)	1,397 0
Reyrolle & Co.	1,728 5
Siemens Bros. & Co.	1,957 5
Richardsons, Westgarth	3,519 0

FOR MAIN SWITCH-GEAR.

British Thomson-Houston Co. (accepted, at £506), single-phase, £506, two-phase, £571.
Ferranti, Ltd. £548, £613.
Cowans, Ltd., £637 10s., £684 15s.
Siemens Bros. & Co., £731, £768.
British Westinghouse Co., £860, £905 10s.
Brush Electrical Engineering Co., £1,005, no quotation for two-phase.
Richardsons, Westgarth, £1,105, £1,355.

For annual supplies of commutator brushes there were 11 tenders. Those of Mr. C. R Heap and Messrs. Le Carbone (the latter for Boudreaux patent brushes) were accepted.

Leith.—Messrs. S. Dixon & Son, Ltd., have been ordered to lay down six sets of Turner's automatic point controllers for the Corporation tramway system.

London.—The London County Council has received the following tenders for the road-work and paving works in connection with the construction of a short length of tramways in Archway Road, Highgate:—

	Tramway construction.	Paving works of street widening.	Total.
Dick, Kerr & Co., Ltd. (recommended)	£4,587 15 9	£1,010 8 5	£5,598 4 2
D. R. Paterson, London	4,807 14 2	1,036 11 9	5,844 5 11
John Mowlem & Co., Ltd. ..	4,920 2 4	1,035 8 7	5,955 10 11
Wm. Griffiths & Co., Ltd. ..	4,954 13 8	1,034 5 10	5,988 19 6
R. W. Blackwell & Co., Ltd. ..	5,037 15 8	1,104 18 6	6,142 14 2
Muirhead, Greig & Matthews ..	5,074 14 0	1,082 1 7	6,156 15 7

The offer of the Metropolitan Electric Tramways, Ltd., is to be accepted for the overhead electrical equipment of the above short lines, at a cost not exceeding £600.

Metropolitan Asylums Board.—The Board received the following tenders on Saturday for the installation of electric light, telephones and fire alarms at the Southern Hospital:—

Buchanan & Curwen (accepted)	£8,400
Bramley & Batstone	8,677
Belshaw & Co.	8,944
Alliance Electrical Co., Ltd.	9,584
F. A. Glover & Co., Ltd.	9,671
Wenham & Waters, Ltd.	10,790
Drake & Gorham, Ltd.	10,819
Higgins & Griffiths	10,850
Bergtheil & Young, Ltd.	11,600

The estimate of the engineer-in-chief was £8,500.

The order for renewing the electrical storage battery at the Northern Hospital for £295, and also to maintain same for 10 years at £28 per annum, has been placed with the Tudor Accumulator Co.

Partick.—The Electricity Committee has accepted the following offers for annual supplies:—

Messrs. Doulton & Co., for troughs and covers.
Messrs. Venner & Co., for meters.
Brockie-Pell Arc Lamp Co., for arc lamp carbons.
British Insulated and Helsby Cables, Ltd., for fuse-boxes.
Messrs. P. & R. Fleming, for stores.

Poplar.—The Lighting Committee has accepted the tender of the Whitwell Coal Co. for the supply of 3,500 tons of Stockingford beans at 10s. 9d. per ton to be delivered during the next six months. The Committee has the option of a second 3,500 tons at the same price during the following half-year.

Ramsgate.—The tender of Messrs. J. W. Woodhall and Son has been accepted for the erection of the electric power station at Ramsgate, at £3,655.

Scunthorpe.—The U.D.C. on May 11th accepted the tender of the British Westinghouse Co., for the supply of engines, dynamos, pumps, motors, cables, &c., for the Waterworks, at £7,134.

Shoreditch.—The B.C. has received the following tenders for 3,800 yards '75 H.T. concentric paper-insulated lead-covered cable:—

Messrs. W. T. Glover & Co., Ltd. (accepted)	£3,234
British Insulated and Helsby Cables, Ltd.	£3,260
W. T. Henley's Telegraph Works Co., Ltd.	£3,260
Siemens Bros. & Co., Ltd.	£3,391.

Southampton.—The T.C. has accepted the tender of the North-Eastern Steel Co., of Middlesbrough, for the supply of 250 tons of tramway parts, at £5 10s. per ton, and that of Messrs. G. R. Turner, Ltd., for two 10-ton coal wagons for the electricity department, at £128.

Woolwich.—Messrs. Browett, Lindley & Co., Ltd., have just received an order from his Majesty's Government for the supply of a 500-KW. steam generator, including one of their three-crank triple-expansion enclosed forced lubrication steam engines, coupled to a dynamo by the British Westinghouse Co., to be installed at the Royal Arsenal, Woolwich, this being an exact duplicate set to that supplied last October.

FORTHCOMING EVENTS.

To-day's Arrangements.—At 7.30 p.m. N.E. Coast Institution of Engineers and Shipbuilders. Closing Business Meeting. Mr. J. F. C. Snell will reply to discussion on "Applications of Electricity to Industrial Purposes."

Monday, May 22nd.—At 8 p.m. Society of Arts. Cantor Lecture by Mr. H. W. Ravenshaw on "The Uses of Electricity in Mines." (Lecture II.)

Tuesday, May 23rd.—At 4.30 p.m. Society of Arts. "The Cape-to-Cairo Railway," by Sir C. H. T. Metcalfe.

Wednesday, May 24th.—At 8 p.m. Society of Arts. "Modern Lightning Conductors," by Mr. Killingworth Hedges.
At 7.30 p.m. I.E.E. Students. Annual meeting. Paper to follow "On E.M.F. Wave Forms," by J. B. Sparks and A. Biederman.

Thursday, May 25th.—At 8 p.m. I.E.E. Meeting at Society of Arts. "Wireless Telegraphy Measurements," by Mr. W. Duddell and Mr. J. E. Taylor.
At 5 p.m. Royal Institution. Prof. J. A. Fleming on "Electro-Magnetic Waves."
Leeds Association of Engineers' Meeting.

Friday, May 26th.—At 5 p.m. At 92, Victoria Street, S.W. I.E.E. Annual General Meeting.

Tuesday, May 30th.—At 8 p.m. Optical Convention, 1905. Opening Ceremony to be held at the Northampton Institute. Closes on Saturday, June 3rd.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders have been issued for next week:—

Monday, May 22nd.—"A" Company. Parade at Headquarters 7 p.m. for "Officers' Cup" competition. Drill Order. Blue. Projector Drill for Members of all Companies. 7 till 9 p.m. "A" Company after Drill Parade.

Tuesday, May 23rd.—"B" Company. Parade at Headquarters, 8 p.m., for "Officers' Cup" Competition. Drill Order. Blue. Medical Inspection for Recruits and Special Service Section, 7 p.m. Projector Drill for Members of all Companies from 7 till 9 p.m. "B" Company after Drill Parade.

Wednesday, May 24th.—No Adjutant's Drill. Examination "A" and "B" Companies for "A" Badge, 7 p.m. Projector Drill for Members of all Companies, 7 till 9 p.m.

Thursday, May 25th.—"C" Company. Parade at Headquarters, 8 p.m., for "Officers' Cup" Competition. Drill order. Blue. Projector Drill for Members of all Companies from 7 till 9 p.m. "C" Company after Drill Parade.

Friday, May 26th.—"D" Company. Parade at Headquarters, 7 p.m., for "Officers' Cup" Competition. Drill Order. Blue. Projector Drill for Members of all Companies from 7 till 9 p.m. "D" Company after Drill Parade.

J. J. F. O'Shaughnessy, Captain.
For O.C.E.E.R.E. (V.)

LONDON POWER BILLS.

Decision.

At the meeting of the Power Bills Committee, held yesterday (Thursday), the Chairman read the following decisions:—"The Committee has decided that the North Metropolitan Electric Power Supply Bill may proceed; that it is inexpedient that the Charing Cross and Strand Co.'s Bill shall proceed; and that it is inexpedient that the City of London Electric Lighting Co.'s Bill should proceed. With regard to the Central Electric Supply Bill, the Committee has decided that it is not expedient to grant them an area of supply, otherwise the Bill may proceed. Of course, when I say proceed, everyone understands that merely means that we may come to clauses. It does not mean that we shall pass any particular clause without consideration. With regard to the County of London Electric Supply Co.'s Bill, the Committee has decided that it is inexpedient to pass those clauses which deal with the linking up of the generating stations and the clauses which deal with the extension—otherwise the Bill may proceed. That leaves the Administrative County of London Bill and the Metropolitan Electric Supply Co.'s Bill. The Committee have these Bills still under consideration. While fully alive to the importance of the supply of cheap power, the Committee have not failed to observe that the introduction of new power companies, not subject to statutory purchase in the areas already occupied by electric companies which are subject to statutory purchase, must necessarily inflict hardship upon the latter, and before arriving at a decision with regard to these two Bills the Committee would be prepared to consider any reasonable suggestions for obviating that hardship."

Considerable discussion followed the decision, and the Chairman said he would rather hear suggestions from the parties themselves than make them himself.

Mr. Hutchinson, for the City of London Co., asked that the Committee would allow his Bill to proceed, so far as the powers were concerned, to authorise the company to supply railways and adjoining areas in bulk.

The Committee adhered to their decision that the Bill should not proceed.

Mr. Baggallay also asked, on behalf of the Charing Cross Co., that the clauses giving power to supply railways, and also to lay mains across the Thames to connect their generating station at Lambeth with their district of supply might be allowed to proceed. He pointed out that the mains did at present exist.

Mr. Freeman said he should object to that, because, while the mains now existed by agreement, the company sought to legalise them.

The Committee refused to allow the Bill to proceed.

Further discussion ensued with regard to some meeting between the parties.

The Chairman said he did not see that the various boards of directors need be formally called together. He felt it was a matter which could be left in the hands of counsel.

Ultimately it was agreed to take the Administrative County of London Bill and the Metropolitan Electric Supply Co.'s Bill on Monday.

NOTES.

Electrical Undertakings and the Rating of Machinery.—Up to the present time the producers of electrical energy have regarded the efficiency of their plant as being a question practically of interest to no one but themselves, and those for whom they cater. It has been brought to its present state of perfection only at a heavy cost, which has been increased because valuable pieces of machinery with probably the greater period of their life still unexpired have often had to be replaced by more modern appliances in order to meet the exigencies of competition. And yet before the industry may be regarded as having attained its majority a further imposition is seriously threatened, for at a recent conference of the London County Council and delegates from the various Metropolitan Boroughs, the following resolution was formulated:—

(*a*) That in the case of premises where the assessable value is enhanced by the presence of plant and machinery essentially necessary to the business carried on, and which it is intended should remain attached to the premises so long as they are used for the purposes of the business, such enhanced value, unless already covered by the rent paid by the occupier, shall be taken into account.

(*b*) That, having due regard to necessary modifications in special cases, 10 per cent. of the capital value of rateable machinery shall be taken as the average percentage for gross value.

(*c*) That the maximum deduction of one-third should not be allowed as a matter of course, but the amount should vary between one-third and one-sixth, according to the proportion of machinery included in the assessment.

If effect be given to this resolution by the rating authorities of London, the rateable value of electrical undertakings will be increased, because machinery that is now considered as belonging to the occupier, and for which a certain proportion of the receipts is at present deducted as representing interest and trade profit on the capital he has invested, will no longer be allowed. Any increase in taxation, however just, is always a hardship, but when it is imposed in direct contravention to law, it is additionally vexatious. While the question is comparatively new to users of machinery in London, it has agitated the minds of provincial manufacturers for many years; at the present time the Machinery Users' Association, which was formed for the purpose of resisting the imposition of a tax upon machinery, is contesting it before the Divisional Courts on behalf of the manufacturers of Leeds, and the result is awaited with great interest. Backed by a strong committee, and numbering amongst its members the largest manufacturers throughout the country, it should have the cordial support of all sections of the manufacturing and industrial community, who are threatened with further additional taxation by the proposals of the London rating authorities, and by the action of similar bodies in all parts of the country.

Influence of Radium Bromide upon the Electrical Resistivity of Metals.—A paper on the above subject was presented a short time ago by B. Sabat to the Académie des Sciences, in which the author's conclusions are as follows:—Radium bromide increases the resistivity of wires of bismuth, iron, steel, copper, platinum, brass, and German silver when it is brought near them. A certain increase in resistivity is to be noticed immediately the metals are exposed to the rays, *i.e.*, before they can be appreciably raised in temperature by direct heat from the radium. If the radium and the wires are left near together for a considerable time, the resistivity increases to an almost constant value; on removing them, it falls again slowly to the original figure. The increase is sometimes greater than that which could be produced by the direct absorption on the part of the wires of the heat emitted by the radium. The author therefore holds that, as the metals absorb Becquerel rays, and especially β rays, they convert part of the radiant energy into heat, which, raising their temperature, increases their resistivity. This view is in harmony with our present notions respecting the β rays, because it is more than probable that the electrons of these rays, which possess much kinetic energy, should raise the temperature of metallic molecules when they act upon them, in the same fashion as the analogous cathode rays do. Metals are raised in temperature much less by β rays than by cathode rays, because the metals have a much lower capacity of absorption for β rays than for cathode rays.

Nickel Electrodes for Alkaline Accumulators.—A German patent has been obtained by M. Roloff and H. Wehrlin for a method of preparing positive electrodes for alkaline accumulators composed partly of silver and partly of nickel. In the positive electrodes of these accumulators the active material is an oxygen compound of nickel or of silver. The latter possess the greater capacity, but, owing to the higher cost of silver, nickel electrodes are generally preferable in practice. If the electrodes are made in the ordinary way of mixtures of the two metals, the voltage of the accumulator does not remain even approximately constant during its discharge. The nickel compound is first decomposed and then the silver, the pressure given by the cell being much lower during the second process. The inventors, however, have discovered that if an electrode is prepared of a very intimate mixture of the two metallic oxides by precipitating a mixed saline solution of such composition that the electrode finally contains 20 gramme-atoms of nickel to 1 gramme-atom of silver, an accumulator can be made of higher capacity than one in which the positive electrode is the hydroxide of simple nickel, and without the drop in potential during discharge. They have found, for example, when the usual green nickel hydroxide electrodes are employed, an average capacity of 0·188 ampere-hour per 1 gramme of metal; but when the electrodes are composed of nickel and silver hydroxides simultaneously precipitated in the manner indicated, the capacity has been 0·31 ampere-hour per gramme of nickel. The potential given by the improved electrode is stated to be the same as that of one consisting of nickel alone, but it remains practically constant until the accumulator is entirely discharged. The increased capacity is probably brought about by a catalytic action of the silver upon the nickel hydroxide.

German Electrical Machinery Imports and Exports.—A somewhat quiet tone is prevailing in the German export trade in electrical machinery, the shipments during the two months ending with February last only reaching a total of 2,210 tons as compared with 2,392 tons in the corresponding period of last year. There has also been a decline in the imports of foreign electrical machinery into Germany, from 202 tons in the first two months of 1904, to 174 tons in the two months ending with February last.

Musselburgh Magistrates and the Smoke Nuisance.—The local manager of the National Electric Construction Co. was recently charged with having, on four days in April last, permitted black smoke to be discharged from the chimney of the Musselburgh Electricity Works. He pleaded not guilty. At the close of the trial the Court held that black smoke issued on the dates in question; that the accused had adopted the very best practical means for preventing smoke, and as far as possible had endeavoured to prevent the escape of smoke; and that they found him not guilty. A rider was added that, in the view of the Court, *proper stoking would avoid any further complaints.*

The wise men of Gotham may now take a back seat.

Motor-Boats.—The following letter has come to hand from the British Empire Motor Trades Alliance, 11, Red Lion Square, London, W.C.:—

"On behalf of the British motor-boat trade, I would like you to make it clear to your readers, that the disastrous results of the recent French motor-boat trials from Algiers to Toulon, do not prove conclusively that the principles of motor-boat construction are entirely wrong, but rather that the principle of employing builders of river boats to construct experimental sea boats is almost certain to end in disaster, more especially when they sacrifice stability to speed.

"To prove this assertion it is only necessary to point to the recent voyage from London to the Shetland Islands, of the British built motor boat *Napier Major*, which ran continuously day and night through weather which the Meteorological Office designated as "a gale" without danger or accidents.

"This is another proof of the ability of British shipbuilders to build their vessels for storm as well as sunshine, and the fullest possible credit should be given to British success in this direction.

"J. B. KING, *Assistant Secretary.*"

Appointments Vacant.—Switchboard attendant, &c., for Mansfield; electrical engineer for Rainhill County Asylum (£120 and house).

Electricity in Mines.—As we go to press, Messrs. Evershed & Vignoles, Ltd., informs us that they have been in communication with the Home Office on the subject of the new rules, as far as they concern the continuous indication of insulation resistance. While acknowledging that the tests contemplated by Clause 7, Sec. 1, cannot be strictly carried out, the Home Office authorities have stated that instruments made in accordance with Messrs. Evershed & Vignoles' suggestions will meet their requirements.

Institution and Lecture Notes.—The report of the Committee of the Manchester Students' Section of the I.E.E. says that the meetings and visits of the session were well attended, the average being for the meetings about 83, and for the visits about 65. The membership, when the Section was formed in March, 1904, was 102, but at the commencement of this session it was 244, while at the end it is 306. The Schwartz Premium was awarded upon the decision of the chairman of the Senior Section, to Mr. D. L. Sands for his paper on "Photometric Testing;" and the Committee has great pleasure in announcing that two more premiums, of two guineas and one guinea respectively, have been offered by Prof. Schwartz for the two best papers read before the Section during the Session 1904-5. The Committee for the Session 1905-6, as elected by ballot on March 31st, 1905, is as follows:—

Vice-Chairman.—Mr. A. E. Jepson.

Members.—Messrs. S F. Barclay, J. W. Campbell, C. W. Crosbie, C. F. Hewitt, M. Jennison, A. Maling, E. G. L Mosley, J. G. Potts, R. W. Willis, W. M. Winstanley, A. R. Wood, and R. C. C. Yates.

Hon. Secretary.—Mr. D. L. Sands, Highfield House, Mary Street, Harpurhey.

The annual meeting of the I.E.E. (Glasgow Section) was held on Tuesday evening, May 5th, Mr. Robert Robertson, chairman, presiding. The new office bearers were elected as follows:—Chairman, Mr. M. M. Munro; Vice-chairman, Mr. Frank Newington; Hon. Secretary and Treasurer, Mr. E. George Tidd; Committee, Messrs. W. W. Lackie, E. T. Goslin, J. K. Stothert, J. Macfee, Sam. Mavor, A. W. Stewart, T. Blackwood Murray, W. Stevenson, and James Lowson.

On May 22nd, at the East London Technical College, Mile End Road, Prof. John T. Morris, M.I.E.E., will commence a special course of lectures on "Electrical Transmission of Energy with Special Reference to Power Schemes." He will, on 24th inst., commence a series of six lectures on "Electric Lighting" at the same place.

At a meeting of the Verein Deutscher Eisenhüttenleute, held at Düsseldorf on 14th inst., Prof. Dr. W. Borchers, of Aix-la-Chapelle, read a paper on "The Present Position of the Electrical Method of Producing Iron and Steel."

On May 8th the Society of Arts resolved not to take any further action in regard to the proposed amalgamation with the London Institution.

At the Royal Institution on Thursday, May 25th, Prof. J. A. Fleming will deliver the first of three Tyndall lectures on "Electromagnetic Waves." The Friday evening discourse on May 26th will be delivered by Prof. J. W. Brühl on "The Development of Spectro-Chemistry," and on June 9th, by Sir William H. White, on "Submarine Navigation."

The inaugural dinner of the Faraday House Old Students' Association was held at the Trocadero Restaurant on Friday last, May 12th, Mr. C. P. Sparks, M.I.E.E., chief engineer of the County of London Co., presiding. Among those present were Sir Joseph Swan, F.R.S., Mr. John Gavey, President-elect of the Institution, Mr. Robert Hammond, Mr. A. P. Trotter, Dr. Mullineux Walmsley, Mr. H. E. Harrison, B.Sc., Mr. Hugo Hirst, Captain H. R. Sankey and Mr. G. W. Partridge, and about 90 members and friends. The toast of "The Association" was proposed by Sir Joseph Swan, who recalled the state of things which existed in 1882, viz., that electrical engineers, as understood to-day, were non-existent. He said it was greatly to the credit of the founders of the Hammond College and the Electrical Standardising, Testing and Training Institution that they so truly foresaw the necessity of a scientific training for the electrical engineers of the future, and that in initiating those institutions they were pioneers of a great revolution and rendered the greatest possible service to the cause and progress of electrical engineering. The promise of the continued extension of the manifold uses of electricity never appeared more bright than at present, and it was, therefore, a singularly fitting time for the foundation of an association which would unite by common bond the students of the old Hammond College and of the present Faraday House. Mr. Sparks, who replied to the toast, referred to the fact that the invention of the glow lamp by their distinguished guest, Sir Joseph Swan, had rendered electric lighting a commercial possibility, and the tremendous industry which had grown up in the last quarter of a century was largely the consequence of this invention. Mr. C. D. Taite, borough electrical engineer of Salford, proposed the toast of "The Electrical Standardising, Testing and Training Institution" in a humorous speech, which was replied to by Mr. Robert Hammond, who referred to the extreme difficulty he experienced in the early eighties in getting properly trained electrical engineers, which compelled him to found his own college for training the men. The toast of "The Guests" was proposed by Mr. H. E. Harrison, and replied to by Mr. John Gavey. A smoking concert followed, and a most enjoyable evening was spent. It is intended that the dinner shall be, at least, an annual affair.

Last Monday night, at the Society of Arts, Mr. H. W. Ravenshaw delivered the first of two Cantor lectures on "The Uses of Electricity in Mines." He dealt first with electric winding, proceeding later to hauling, pumping and coal-cutting.

Our Canals.—On May 10th a conference called by the Worcester Chamber of Commerce was held at Worcester, to consider a proposal to form a trust to work the inland waterways in the Severn district. A committee was appointed to fully consider the matter.

Gas.—In the Boulevard de Sebastopol, Paris, on 11th inst., there was a disastrous gas explosion which tore up the footway for half-a-kilometre or more, and injured 14 persons.

The Electro-Metallurgy of Zinc.—A limited company has been formed in Belgium, under the name of the Société Anonyme Métallurgique Procédé de Laval, to work the De Laval process for the electric smelting of zinc. It is stated that the Schuckert Co., of Nürnberg, is interested in the venture.

An Electrically-Equipped Swing Bridge.—Sydney harbour is now equipped with two swing bridges whose interest to electrical engineers lies not only in their size, but in the fact that all the movements of the bridge are performed by electric motors operated by one man from one point. These bridges are situate at Pyrmont and Glebe Island, are almost identical in build and equipment, and their size may be gauged by the fact that the Pyrmont bridge weighs about 900 tons, has a span of 223 ft., and daily carries an average of 11,825 pedestrians, 5,288 vehicles and 7,645 head of livestock. The motors are supplied with 500-volt direct current from the tramway system. The slewing is effected by two series-wound motors with series-parallel control (one being of sufficient power to perform the operation if necessary), taking 89 H.P. maximum to open the bridge in 30 seconds, or 15 H.P. maximum, if the motion is spread over 60 seconds. The average time taken in practice is 50 seconds. In order to counteract the deflection of 3½ in. on the ends of the bridge when hanging free of the abutment piers, the ends are raised 1½ in. by a cam motion attached to a shaft running the length of the bridge under each of the two main girders, and operated by a G.E. 1,000 motor, when closing the bridge. This partial lift also prevents chattering of the bridge when heavy loads are passing over it. The operation of lifting the ends takes 15 seconds, the motion being stopped by an automatic circuit-breaker and solenoid brake attached to the motor, and operating when the correct lift has been made. Each of the four gates closing the ends of the abutment piers to traffic when the swing bridge is open, is operated by a slotted crank motion, driven by a 5-H.P. motor. Twenty-five arc lamps, some of which are provided with ruby glass warning-signals to mariners, complete the electrical equipment, which is controlled from a house situated above the footpath at the centre of the span. This contains the necessary controllers, switches, circuit-breakers and ammeters, and dial indicators showing the operator the position of the swing span and end lifts at any moment. The energy is metered by a Thomson integrating wattmeter, and as the result of two years' working the complete cost of operation of the bridge has been 235

dollars at 2 cents per unit. In this time the bridge has been slewed 12,317 times for the passage of 21,758 vessels, 98,536 operations being involved. Expense of attendance is a minimum, as the bridge is handled by one man. The design and erection of the bridge stands to the credit of Mr. Percy Allen, while the electrical installation was carried out by the Australian General Electrical Co.

What is an Accident?—The true legal meaning of the term "accident" has been much canvassed in cases which have arisen under the Workmen's Compensation Act, and the trend of the decisions appears to be to enlarge the meaning of the expression "accident arising out of and in the course of the employment" as much as possible in favour of the workman. A recent case supplies authority for the proposition that if a workman is in feeble health, or is predisposed to any dangerous disorder, the employer may be held liable for all the consequences of an accident to such a workman, although it may be shown that a healthy subject would not have suffered to the like extent. In the case in question a stevedore who was subject to epileptic fits, was overcome with faintness when standing, in the course of his employment, close to the open hatchway of a ship. He fell into the hold and broke his leg. The employers were held liable, the Court of Appeal holding that they were bound to look at the *causa proxima* of the injury, which was the fall into the hold. In a case which was heard last year, a man who was employed upon a railway fell and broke his leg. The injury disabled him for several months, during which the company paid him compensation. After he had recovered from the fracture, he found that he could not return to work owing to *locomotor ataxia*, which deprived him of the use of his limbs. The employers applied to the Court for a review of the weekly payments, alleging that as the man had recovered from the injury caused by the accident, they were no longer liable. The medical witnesses proved that he was suffering from *locomotor ataxia* when he broke his leg; so that that disease would probably have disabled him at some time or other, but that its progress was hastened by the accident. In the light of this evidence, a County Court Judge held in effect that the total permanent disability had been caused by the accident, and that the employers must pay compensation on that basis. These cases show that employers should have regard, not only to the age, but to the physical capacity of the workmen whom they employ, if they wish to avoid the extraordinary risks to which they are exposed under the Act of 1897.

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—Sixty-nine applications were received for the position of mains superintendent to the Bermondsey undertaking at £170 a year. At the meeting of the Borough Council on Tuesday the three selected candidates were called in and questioned. The Mayor gave his casting vote for Mr. L. A. Laws, who was accordingly declared elected. Mr. Laws, who is 44 years of age, has for the last six years and nine months been mains superintendent to the Lincoln Corporation. Previously he was chief petty officer in charge of all electrical apparatus on H.M.S. *Majestic* and *Vernon*.

Mr. BERNARD HUDSON, of the British Westinghouse Manufacturing Co., Manchester (turbine department), has been appointed shift engineer to the Great Northern Railway Co., Holloway, London.

The Lighting Committee of Brighton T.C. has recommended that the salary of Mr. JOHN CHRISTIE, electrical engineer, shall be increased from £500 to £750 per annum, rising by £50 a year to £1,000, his engagement with the Corporation to be for six years.

Mr. W. CUTHBERT MOORE, electrical engineer of East London, Cape Colony, has resigned on the score of ill-health.

Mr. T. P. PASK, the chief assistant electrical engineer to the Natal Government Railways, was presented by the staff of the new power station, Pietermaritzburg, with a handsome case of pipes on his leaving the city to take up his duties in Durban. Mr. G. F. A. NORMAN, late assistant to the Harrogate Corporation, has been appointed to the vacant position at Maritzburg as district electrical engineer.

The staff at the Barking electricity works have presented a chronograph stop watch to Mr. R. J. J. SWAN, assistant electrical engineer, who is leaving to take up the position of chief engineer at Chesham, to the Empire E.L. and Power Co.

Mr. D. M. MACLEOD, assistant borough electrical engineer at Poplar, has resigned, in consequence of having obtained an appointment with the Clyde Valley Electric Supply Co. The salary of the vacant position in Poplar is £200, rising by annual increments of £10 to £300.

General.—Our readers will be interested to learn that Mr. HORACE ALLEN has commenced business at Central Chambers, 17, Cheapside, London, E.C., as a civil engineer and metallurgical chemist. Mr. Allen has had most exceptional experience, extending over many years, in connection with gas engines and producer plants, both large and small, and his articles in these columns have made him familiar to readers of the ELECTRICAL REVIEW as an authority on these and other subjects, especially including the utilisation of blast-furnace gases for power purposes. The recent developments in these directions and in suction gas producers have led Mr. Allen to place his extended designing and works' experience at the service of consulting engineers, corporations and private firms who may be considering, or about to consider, economical power applications of the classes mentioned. He has personally superintended the design, construction, erection and running of many successful installations, both gas and oil, and he has acquired abundant practical knowledge of these subjects, which should render him of valuable assistance as an independent expert. Mr. Allen, in entering upon this new step, has our best wishes for his success.

The employés of the General Electric Co, Ltd., Glasgow, along with a few old friends of the firm, gathered in White & Smith's restaurant last Friday evening to welcome home the manager, Mr. HENRY W. WARDE, who now resumes business after his recent serious accident. Mr. Sims presided, and an enjoyable programme of song and sentiment was indulged in; when Mr. Quinton Henderson replied to the toast, "The Visitors."

The Brighton Telephones Committee has recommended the Corporation to increase the salary of Mr. D. J. BARNES, from £250 to £300 per annum, on condition that he is responsible for, and is to carry out all works in connection with, the extension of the telephones undertaking.

Mr. HERBERT LAWS WEBB has recently made a trip on telephone matters in France and Spain, and is leaving town this week on a short voyage to America, also to look into telephone progress.

Dr. SHELFORD BIDWELL, F.R.S., is removing from Riverstone Lodge, Wimbledon Park Road, Southfields, Wandsworth, S.W., to Beechmead, Oatlands Chase, Weybridge.

NEW COMPANIES REGISTERED.

Mexborough and Rawmarsh Construction Syndicate, Ltd. (84,583).—This company was registered on May 13th, with a capital of £175,000 in £1 shares, to adopt an agreement with the National Electric Construction Syndicate, Ltd., to construct, lay down, establish, fix and carry out all necessary cables, wires, stations, lines, accumulators, dynamos, batteries, engines, lamps, meters and works, and to carry on the business of railway and tramway proprietors, suppliers of electric light and power, electrical engineers, workers in metals, contractors for the supply of electrical plant, manufacturers of and dealers in all apparatus and things capable of being used in connection with the generation, distribution, supply, accumulation and employment of electricity, &c. The first subscribers (each with one share) are:—W. B. Cownie, 22, King's Avenue, Muswell Hill, N., chartered accountant; F. E. Stanley, 34, Victoria Street, S.W., electrical engineer; R. Watson, 34, Victoria Street, S.W., accountant; W. C. Bishop, 8, Ulysses Road, West Hampstead, N.W., clerk; P. F. Lucas, 32, Upper Gloucester Place, N.W., gentleman; J. T. Jervis, Queen Anne's Chambers, S.W., M.I.C.E.; and W. Escott, 29, Powell Road, Clapton, N.E., gentleman. No initial public issue. The number of directors is not to be less than three nor more than seven; the first are L. B. Schlesinger, W. H. Fowler, B. Bernheim, and J. T. Jervis; qualification, £100; remuneration, £50 each per annum (chairman, £150). If and when the shareholders, on realisation of the securities which may accrue the company, shall receive a capital profit exceeding a total of 20 per cent., the directors are to receive as further remuneration 10 per cent. of the realised profit in excess of such realised profit. Registered office, 34, Victoria Street, S.W.

Thomas Potter & Sons, Ltd. (84,541).—This company was registered on May 10th, with a capital of £2,000 in £1 shares, to acquire the business formerly carried on by H. F. Joel & Co., and Thomas Potter & Sons, United, Ltd., at 43, 44 and 45, South Molton Street, London, together with the lease of the said premises, to adopt an agreement with G. A. Gale, and to carry on the business of electrical, mechanical, and general engineers, suppliers of electricity for light, heat, motive power or otherwise, &c. The first subscribers (each with one share) are:—C. G. Procter, Weyles, Pinner Road, Harrow, engineer; A. H. Robinson, 10, Great Ormund Street, W., accountant; G. L. Garton, 4, Robertson Street, Lavender Hill, S.W., electrical engineer; H. Saunders, 149, Mortimer Road, Kensal Rise, W., clerk; H. J. Potter, 161, Wharncliffe Gardens, St. John's Wood, N.W., art metal worker; W. C. Woodmason, 39, Bedford Gardens, W., salesman; A. E. Ballinger, 10a, Lubeck Street, Clapham Junction, S.W., clerk; and G. R. S. Chandler, 1, Cedars Road, Barnes, accountant. No initial public issue. The number of directors is not to be less than three, nor more than eight; the first are G. R. S. Chandler and C. G. Proctor; qualification, 100 shares. Registered office, 44, South Molton Street, S.W.

Millennium, Ltd. (84,577).—This company was registered on May 12th, with a capital of £1,000 in 5s. shares, to acquire any inventions relating to portable electric lamps, absorbent storage batteries and automatic puncture closers for pneumatic tires, to enter into an agreement with G. H. Smith for the acquisition of the patents and goodwill of the British Steam Traction Syndicate, Ltd., and to carry on the business of electricians, engineers, lamp manufacturers, cycle and motor manufacturers, &c. The first subscribers (each with one share) are:—J. Oldfield, 33, London Road, Bromley, Kent, gentleman; P. Ewens, 5, Austin Friars, E.C., civil engineer; W. H. Wreford, 6, Dowgate Hill, E.C., incorporated accountant; F. Barnes, 177, Temple Chambers, E.C., oil merchant; P. C. Atkins, 81, Cannon Street, E.C., solicitor; R. A. Hudson, 16, Poultry Chambers, E.C., asbestos merchant; and W. Fudge, 17, Waterloo Street, Camberwell, S.E., printer. No initial public issue. The number of directors is not to be less than two nor more than six; the first are not named; qualification, £50; remuneration as fixed by the company. Registered office, 15, Poultry Chambers, E.C.

Clift Manufacturing Co., Ltd. (85,505).—This company was registered on May 8th, with a capital of £10,000 in £1 shares, to acquire the business of manufacturers of switchboards and other electrical appliances for lighting and traction carried on by W. J. Fryer at Bravington Road, Harrow Road, N.W., as the Clift Manufacturing Co., and to carry on the same and the

business of contractors, electrical engineers, gasfitters, brass-finishers, founders, &c. The first subscribers (each with one share) are:—W. J. Fryer, Kalyis House, Maidenhead, contractor; W. Mansell, Bravington Road Works, Harrow Road, N.W., works manager; R. W. Fryer, Sunnyholme, Taplow, Bucks, traveller; J. V. Myren, Lozwood, Cranley Gardens, Wallington, accountant; F. A. Myren, 15, Alexandra Road, St. John's Wood, N.W., clerk; F. J. Simpson, 27, Cromer Street, W.C., clerk; and J. P. de Veulle, 38, Arica Road, Brockley, clerk. No initial public issue. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; qualification, £500; remuneration as fixed by the company. Registered office, 27, Chancery Lane, W.C.

Kerry Electric Supply Co., Ltd. (2,974).—This company was registered in Dublin on May 15th, with a capital of £2,000 in £1 shares, to acquire and carry on the business of generating and supplying electric light and energy for any purpose now carried on by the "Killarney Electric Lighting Co., Ltd.," at Killarney, Co. Kerry. The first subscribers (each with one share) are:—V. A. Ryan, 22, Leeson Park, Dublin, engineer; T. Traynor, 44, Rathdown Road, Dublin, gentleman; Mrs. C. Ryan, 14, Sandford Road, Dublin; R. Bell, Ballymote, land agent; J. B. Ryan, 22, Leeson Park, Dublin, gentleman; Miss M. Ryan, 22, Leeson Park, Dublin; and Miss H. Ryan, 22, Leeson Park, Dublin. Registered without articles of association. The first directors are V. A. Ryan, T. Traynor and R. Bell. Registered office, Killarney, Co. Kerry.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

W. T. Glover & Co., Ltd., electric cable manufacturers, Manchester (56,124).—Issue, on April 6th, of £1,000 second mortgage debentures, part of series created March 27th, 1902, to secure £100,000, charged on the company's undertaking and property, present and future, including uncalled capital, subject to £100,000 first mortgage debenture stock. No trustees. Previously issued of same series: £99,000. A mortgage dated April 6th, 1905, to cover £16,100 (being as to £1,000, part thereof, an additional security to abovementioned debentures), has been registered. Property charged: £80,000 second debentures (part of the said series of £100,000) issued to the Manchester and County Bank, Ltd., and all moneys recoverable thereunder, subject to the rights of the said bank. Trustee: C. Cooper, 33, Princess Street, Manchester.

Indian Electric Supply and Traction Co., Ltd. (84,233).—A trust deed, dated April 20th, 1905, securing £125,000 "Construction" debenture stock, has been registered. The company covenants, when Cawnpore undertaking is completed, to execute a mortgage thereof in favour of trustees in accordance with Indian law, with power to previously execute in England a charge on such undertaking, to be merged in the Indian mortgage when created. Trustees: F. L. Harris, M.P., 4, Green Street, Park Lane, W.; and E. E. Bird, 58, Cadogan Place, S.W.

Sheerness and District Electric Power and Traction Co., Ltd. (65,749).—Issue, on May 1st, of £15,000 debentures, part of series created March 7th, 1905, to secure not more than half the company's issued capital (amount at present issued, £50,000).—Property charged: The company's electric lighting and light railway undertaking, present and future, and its uncalled capital. No trustees. No previous issue of same series.

Electric Ignition Co., Ltd., Birmingham (83 984).—A trust deed, dated April 10th, 1905, and a debenture of even date, securing £2,000, have been registered. Property charged (by debenture): The company's undertaking and property, present and future, including uncalled capital, but excluding unissued capital. (By trust deed): Manufactory and premises known as the Royal Wellington Works, in Sampson Road, Birmingham, and the goodwill of the company's business. Holder: H. Lewis, Langleigh, Olton, Warwickshire. Trustees: H. Lewis and J. W. Lewis, Dominion Works, Upper Dean Street, Birmingham.

Ernest F. Moy, Ltd. (47,408).—This company's annual return was filed on April 18th, when 8,082 ordinary and 1,470 preference shares had been taken up out of a nominal capital of £10,000 in 8,500 ordinary and 1,500 preference shares of £1 each. £1 per share has been called up and £9,552 has been received. Mortgages and charges: £1,270.

Folkestone Electricity Supply Co., Ltd. (51,825).—This company's annual return was filed on April 22nd, when the entire capital of £100,000 in 20,000 shares of £5 each had been taken up and paid for in full. Mortgages and charges: £50,000.

Guildford Electricity Supply Co., Ltd. (36,725).—This company's annual return was filed on April 20th, when 7,196 preference and 2,692 ordinary shares had been taken up out of a nominal capital of £55,000 in 25,000 preference shares of £1 each and 6,000 ordinary shares of £5 each. £1 per share has been called up on the preference and £5 per share on the ordinary shares, resulting in the receipt of £20,658, including £2 paid on two forfeited shares. Mortgages and charges: £21,000.

City of London Electric Lighting Co., Ltd. (34,406).—This company's annual return was filed on April 20th, when 40,000 preference and 70,595 ordinary shares had been taken up out of a nominal capital of £1,200,000 in 40,000 preference and 80,000 ordinary shares of £10 each. £10 per share has been called up, resulting in the receipt of £1,105,950. Mortgages and charges: £800,000 (including premium on redemption, £100,000).

Southern Electric Free Wiring Co., Ltd. (64,550).—This company's annual return was filed on May 8th, when 1,460 shares had been taken up and paid for in full out of a nominal capital of £5,000 in £1 shares. No mortgages and charges.

Bromley (Kent) Electric Light and Power Co., Ltd. (54,127).—This company's annual return was filed on April 28th, when 14,000 shares had been taken up out of a nominal capital of £100,000 in 20,000 shares of £5 each. £5 per share has been called up and £70,000 has been received. Mortgages and charges: £60,830.

Direct Spanish Telegraph Co., Ltd. (6,732 C).—This company's annual return was filed on April 15th, when 12,931 ordinary and 6,000 preference shares had been taken up out of a nominal capital of £95,000 in 13,000 ordinary and 6,000 preference shares of £5 each. £5 per share has been called up, and £94,655 has been received. Mortgages and charges: £20,000 4½ per cent. first mortgage debentures and £20,000 4½ second mortgage debentures.

Okonite Co., Ltd. (69,327).—This company's annual return was filed on April 19th, when the entire nominal capital of £120,000 in 32,000 preference and 16,000 ordinary shares of £2 10s. each had been taken up. £2 10s. per share has been called up on 100 ordinary and 110 preference, and £625 has been received; £119,475 is considered as paid on the remainder. Mortgages and charges: £62,500 (of which £36,600 are in the hands of trustees for the company).

ELECTRICITY SUPPLY ACCOUNTS.

The North of Scotland Electric Light and Power Co.'s Supply Accounts.

We give herewith the returns of this company's Montrose and Brechin stations, tabulated in our usual form. The returns are interesting as showing the progress of electric lighting in the smaller Scottish towns, the population of Montrose being 14,000, and that of Brechin 9,000.

In connection with both concerns, free wiring is undertaken, resulting in a profit of £35 in the case of the former, and a deficit of £28 in the case of the latter town, these amounts being added and subtracted respectively in the profit statement.

GENERAL STATEMENT FOR YEAR ENDING DECEMBER 31ST, 1904.

—	Montrose.	Brechin.
Total capital expended ..	£37,445	£31,543
Total energy generated in units	206,266	103,945
Units sold :—		
Public lamps and contract	48,095	23,142
Private consumers by meter	101,384	51,873
Total units sold	149,479	75,015
Equivalent 8-C.P. lamps connected January 1st, 1904	11,670	7,359
Equivalent lamps connected December 31st, 1904	15,130	12,031
Number of public lamps..	206 16-C.P. incandescents 8 ½-Nernst 54 ½-Nernst 20 arc lamps	179 10-C.P. incandescents 71 20-C.P. incandescents 4 ½-ampere Nernst
Total maximum supply demanded..	135 KW.	79 KW.
Capacity of dynamos ..	282 KW.	128·2 KW.
Load factor	12·6 per cent.	10·8 per cent.
Prices charged—Lighting	6d. and 4d. M.D.S., 5½d. flat rate, and 4½d. churches	6d. and 4d. M.D.S. 5½d. flat rate, and 4½d. churches
Power	4d. and 1½d. M.D.S., and 2½d. flat rate	4d. and 1½d. M.D.S., and 2½d. flat rate.
Public lamps	Arcs, £10 16-C.P. Inc., £1 ½-amp. Nernst, £2 8s. ¼-amp. Nernst, £1 6s. per 1,000 lamp hours	12s. per 1,000 hours, per 10-C.P. lamp.
Average price obtained ..	3·84d.	4·48d.
Average for private lighting and motors	3·8d.	4·9d.
Average for public lamps	4·0d.	3·4d.

REVENUE ACCOUNT.

	Montrose. Per unit.	Brechin. Per unit.
Gross revenue	£2,698 = 4·34d.	£1,559 = 5·0d.
Works and distribution costs	£1,000 = 1·60d.	£624 = 2·0d.
Total working costs	£1,336 = 2·15d.	£974 = 3·13d.
Gross profit	£1,362 = 2·19d.	£585 = 1·87d.

PROFIT STATEMENT, 1904.

Interest on outstanding accounts	£1,695
Balance, net profit	727
Brechin wiring account	29
Balance brought forward from 1903	−470
„ Montrose wiring account	− 34
Gross profit (Montrose and Brechin)	£1,947

CITY NOTES.

Globe Telegraph and Trust Co.

The meeting of this company was held on Tuesday at River Plate House, the Marquis of Tweeddale presiding. In moving the adoption of the report and accounts, the CHAIRMAN said that the receipts for the year ending the 30th ult., after deducting expenses, had amounted to £199,123, which sum was increased by the balance brought forward to £202,180. They had paid three interim dividends of 2s. each on the ordinary shares, in addition to the fixed dividend on the preference shares. The directors now recommended a dividend of 4s. 9d. per share, which, with the previous distributions, would make 5⅝ per cent. for the year on the ordinary shares. It was not quite so large a return as that for the previous year, when the largest dividend since the inception of the company was paid. But so far as the directors could see the slight fall was only temporary. During the year the capital of the company had been increased by the issue of 250 preference shares at a premium, and a similar number of common shares at par, the object having been to invest the proceeds of the issue in the Western Telegraph Co's. shares. That had been effected at remunerative prices. There had been certain variations in their receipts as compared with those of the previous year, from several of the companies in which they were

interested. The company had a considerable holding in the Indo-European Co., whose dividends for some years had been very good, viz., 10 per cent. Just after the close of their financial year they received in addition to the usual dividend a bonus of 3 per cent., which amounted to £3,514. That additional sum had therefore gone to the credit of the new year. In 1893 when he addressed them there was a depreciation of £273,381 in the market value of their investments. Last year an appreciation of £43,259 was shown, and that figure had now been raised to £472,744. There had, therefore, been an improvement of about £700,000 during the past three years. In conclusion, he said he thought that the shareholders would agree with him that the company was in a satisfactory position.

The motion was seconded by Sir JOHN WOLFE BARRY, and carried.

Other business having been transacted, the proceedings terminated.

West India and Panama Telegraph Co.

THE directors' report for the six months ended December 31st, 1904, states that the amount to credit of revenue is £27,136, against £32,400 for the corresponding half-year of 1903. The expenses have been £21,422, against £25,243, leaving a balance of £5,714, to which is added £1,839 interest on investments, and £1,583 brought from last account, making a total of £9,135, with which it is proposed to deal as follows:—Payment of 5s. per share on account of arrears of dividends to December 31st, 1904, on the first preference shares, £8,641; balance to current half-year's account, £494 = £9,135. This will leave the following dividends in arrear:—On the first preference shares, £3,456; on the second preference shares, £12,606 = £16,062.

The expenses of repairing cables during the half-year were £10,424 10s. 9d. against which the sum of £4,050 has been received for the charter of the company's repairing steamer *Henry Holmes*. These expenses are, however, exclusive of a further expenditure of £8,446 10s. 2d., which has been charged to reserve, in respect of 40 knots of new cable used in the repair and partial renewal of the two cables between Jamaica and Porto Rico. The directors regret that, instead of the expected improvement in the company's traffic receipts, there has been a decrease during the half-year of £1,862, as compared with the corresponding period, and that those for the current half-year also show a decline. In December a contract was entered into with the Telegraph Construction and Maintenance Co. for the manufacture of 215 knots of cable for stock, which have since been delivered in the West Indies. Owing to continued ill-health, Mr. Andrews has resigned his seat at the board. Mr. Le Rougetel having terminated his connection with the International Ocean Telegraph Co., resigned his position as their nominee on the board of this company. The International Co. nominated Mr. Tom Waldemar Goulding as a director in his place, and he has been elected to a seat at the board.

West African Telegraph Co.

THE directors' report for the year ended December 31st, 1904, states that the revenue for the period under review amounted to £60,915, from which is deducted £14,995 for the ordinary expenses, and £9,840 for expenditure relating to maintenance of cables, leaving a balance of £36,080, to which is added £2,663 brought from the preceding year, making a total available balance of £38,743. The sum of £1,667 has been provided for income-tax, £25,000 has been transferred to general reserve fund, and an interim dividend of 2 per cent., absorbing £4,622, was paid on December 1st last. The directors recommend the payment of a final dividend of 2½ per cent., making, with the interim distribution, 4½ per cent. for the year, the balance of £1,676 being carried forward. The liability of the company to maintain certain cables on the West Coast of Africa, in accordance with the arrangement entered into with the French Government dated February 10th, 1902, expired in September, 1904.

Western Telegraph Co.

THE meeting of this company was held on Wednesday at River Plate House, Sir J. Wolfe Barry in the chair.

In proposing the adoption of the report, the CHAIRMAN said that the trade and commerce of the countries of South America had steadily increased, and their vast resources were being satisfactorily developed, and their company had participated in the progress that South America was making. Their message receipts for the half-year under review had amounted to £227,324, as against, for the corresponding period of 1903, £202,062, showing an increase of £25,262, to which almost all classes of traffic had contributed. That satisfactory state of affairs was being continued up to the present time in the current half-year. The general expenses in London showed a net increase of £177, and those at the stations a net decrease of £1,220. There had been increases amounting to £2,604 under the heads of salaries and wages, expenses of training staff, repairs, &c.; but, on the other hand, there had been savings amounting to £3,824 in such matters as travelling expenses, rent, taxes, &c. Repairs to cables and expenses of ships showed a net increase of £12,584. Improved apparatus for cable working at the stations had necessitated an increased expenditure of £690. The 5 per cent. debentures repayable on June 30th next year had been reduced by £13,000, and during the half-year a further amount of £22,000 4 per cent. debenture stock had been issued at a small premium. The capital expenditure had been increased by £6,052, being the cost of new offices in Monte Video. After providing £14,065 for interest on debenture stock, and interest on debentures and sinking fund and £4,821 for income-tax, there remained a balance of £123,831, to which had to be added £4,439 brought forward from last half-year, making a total of £128,270. The first and second interim dividends amounting to £62,379 had been paid, and after transferring £60,000 to the general reserve fund and £2,000 to the maintenance of ship's reserve fund, there remained a balance of £3,891, which they proposed to carry forward to the next account. A matter which had been discussed by shareholders of that and other telegraph companies had again been brought before the directors by a highly respected shareholder who advised the paying of larger dividends, and not adding to the reserve funds from year to year more than the interest derived from those funds. As he had said at a previous meeting, the board were against any alteration of their usual procedure—that was to endeavour to maintain a steady dividend and bonus, and not to attempt to divide the profits up to the hilt. He believed that in such an enterprise as telegraph cables it was much more to the true interests of their shareholders to possess a steady rather than a fluctuating dividend, and to see the company grow strong in reserve strength. That was the policy which they had pursued for many years, and which had made the shares of British telegraph companies—and especially those of the associated companies—a sound investment.

Sir JOHN DENISON PENDER seconded the resolution, and the report was adopted.

Callender's Cable and Construction Co.

THE directors' report for the year ending December 31st, 1904, shows a balance at the credit of profit and loss for the year's working of £57,066, to which is added the balance of £24,581 brought forward, making £81,647. Interest on debenture stock absorbs £11,250; dividend on preference shares, £10,000; appropriation for depreciation of plant and machinery, £12,167; appropriation for depreciation of office furniture, £171; and after deducting the balance of cost of the issue of debenture stock, £2,778, there is an available balance of £45,282. It is proposed to pay a dividend on the ordinary shares at the rate of 10 per cent. per annum (clear of income-tax), being 10s. per share, whereof 5s. was paid on November 1st, 1904, and 5s. will be paid on May 31st, 1905; pay a bonus of 2s. 6d. per share on the latter date, and to carry forward to next year's account, £23,407. The directors consider that the shareholders have every reason to be content with the result of the company's operations, as, in spite of a considerably reduced volume of business, the profits have been over £4,000 in excess of those of last year, notwithstanding the lamentable condition of trade, and the consequent keen competition which prevailed during the greater part of 1904.

"The stringency of the money market, and the resulting inability of local authorities and others to obtain capital for new works, and even for extensions, are matters of universal knowledge, and have of necessity restricted the company's trade in all parts of the United Kingdom. Happily, the monetary outlook is now much improved, and the business offering has lately shown a satisfactory increase. Prices, however, still leave much to be desired. Important contracts have already been secured at home and abroad to be carried out this year, and the factory at Erith will be kept busy for some time to come with the orders actually in hand. The company has carried out a large amount of work in connection with the supply of electric power in South Wales, in the Cleveland district, and in Yorkshire. Practical experience has shown that the policy adopted two years ago in regard to the companies supplying large areas with electricity under Parliamentary powers is a sound one. Further extensive orders are in course of execution for additional mains in these districts, and for new power mains in Lancashire, Derbyshire, Fife and elsewhere. During the past year a considerable extension of the company's business has taken place abroad, especially in the East. Cable-laying contracts have been completed, or are in progress in Bombay, Calcutta, Kandy, Penang, Kuala Lumpur, Singapore, and Hong Kong, whilst further orders are now in course of execution for Bangkok and the Kidderpore Docks. Contracts have also been carried out in New Zealand, at Wellington and Dunedin. Considerable orders have been executed in Mexico, and the company's staff is now cable laying in the Argentine. In conjunction with other well-known firms in the engineering trade, the company has taken part in the establishment of the British Engineering Co. of Egypt, Ltd., with the view of securing satisfactory representation in that country when the time comes for the execution of heavy electric contracts there. The company is now reaping considerable advantage from the expenditure on plant and appliances made at the factory during the past five years. It has thus been possible to produce cables at a profit during the difficult and trying time through which the company has passed. Notwithstanding the cost of considerable additional plant, after deducting the amount placed to depreciation for the year, the Erith Works stand in the balance-sheet at a somewhat less sum than in 1903. The machinery, plant, and equipment at Erith, and on outside contracts have been maintained in the most efficient condition, the cost thereof being debited to the year's revenue. The directors call attention to the heavy burden upon the company from the local rates and taxes, the amount payable having been considerably increased during 1904. At Erith alone, the sum paid amounts to £3,741 per annum, which is equal to a dividend of 2½ per cent. on the ordinary share capital of the company."

The operations of the Anchor Cable Co., Ltd., whose shares are held by this company and its nominees, have been considerably restricted during the past year, owing to the unsatisfactory position of the rubber trade, due to the unprecedented advance in

the cost of raw materials, with no corresponding increase in selling prices. The policy of the Anchor Co. has therefore been a waiting one, but the plant and machinery at Leigh have in the meantime been put into excellent order, and the trade connection has been considerably increased. It has been shown by events which have occurred during the past year, that the control of the Anchor Works has already been of great advantage to the company's business, and the directors are confident that it will continue to be so. As anticipated at the time of purchase, the clearing up of the contracts undertaken by the old management has been attended with heavy expenditure. A sum has been set aside out of the company's profits towards meeting the loss thus caused, which will be dealt with when the Anchor Co. is finally incorporated with this company. A further issue of debenture stock amounting to £100,000 was made during the past year, and was readily accepted by the investing public. The cost of this issue is charged in the balance-sheet. The directors regret to announce the death of Lieut.-Col. Elliot, which took place in July, 1904. He had been a member of the board of directors since the formation of the company. The vacancy thus caused has been filled by the election of Sir J. Fortescue Flannery, Bart., M.P.

Brisbane Electric Tramways Investments Co.

The report for 1904 states that the dividends on the shares held by this company amount to £43,970; there was also brought forward from previous year, £5,673. After paying debenture interest and preference dividend, the directors propose to transfer to reserve fund (bringing it up to £14,216) £5,000; to accidents insurance fund, £500; to pay the balance dividend on the preference shares, making up the full dividend at the rate of 5 per cent. per annum, carrying forward £2,719. Notwithstanding the opening of the Toowong extension and the increased car-mileage run, the gross earnings for 1904 remain practically the same as in 1903. This comparatively disappointing result is due to the consequences of the protracted drought of recent years, the recovery from which is necessarily slow. Notwithstanding the increased mileage in 1904, the total expenditure was actually slightly less than in 1903. The working of the tramways for the year resulted in a net profit of £47,186, to which must be added the amount brought forward from 1903, £2,722, leaving a balance of profit available of £49,908. This has been appropriated by the tramways company as follows:—In placing to credit of a fund for renewals (bringing it up to £9,000), £3,000, in payment of dividends on shares, £44,000, carrying forward to next account £2,908.

County of London Electric Supply Co.—The amount of electricity sold in the company's London districts during the quarter ended March 31st is estimated to realise about £41,895, which compares with £37,925 for the corresponding period of last year.

Castner-Kellner Alkali Co.—The report to March 31st states that the net profit, after the usual expenditure in keeping up the works, plant, and machinery to the highest state of efficiency throughout the year, was £52,358, making, with the amount brought forward, £64,155. After deducting debenture interest, the directors recommend that £15,000 be appropriated to depreciation reserve, increasing that account to £85,000; that a further sum of £8,204 be written off plant, patents, and suspense accounts, and that a dividend at the rate of 4 per cent. be paid for the year ended March 31st, amounting to £18,000, leaving £12,798 to be carried forward.

Stock Exchange Notices.—Applications have been made to the Committee to allow the following securities to be quoted in the Official List:—

Baker Street and Waterloo Railway Co.—£500,000 4 per cent. debenture stock, in lieu of the Speyer Brothers' scrip certificates now quoted.

British Electric Traction Co., Ltd.—Further issue of £448,653 5 per cent. perpetual debenture stock; and £158,623 4½ per cent. second debenture stock.

Consolidated Electrical Co., Ltd.—110,000 ordinary shares of £1 each, fully paid.

County of London Electric Supply Co., Ltd.—£250,000 4½ per cent. second debenture stock, in lieu of the provisional certificates now quoted, together with a further issue of £150,000 4½ per cent. second debenture stock.

Rosario Electric Co., Ltd.—12,000 6 per cent. cumulative preference shares of £5 each, fully paid.

The Committee have ordered the undermentioned securities to be quoted in the Official List:—

Charing Cross, West End, and City Electricity Supply Co., Ltd.—Further issue of £70,000 4 per cent. debenture stock.

Submarine Cables Trust Co.—The meeting of this company was held on Tuesday at Electra House, the Marquis of Tweeddale presiding. After briefly referring to the business of the year, which showed a decrease of £269 as compared with 1903, due to reduced dividends on their Anglo-American Telegraph shares, he moved the adoption of the report. Sir J. Denison Pender seconded, and it was carried.

Ferranti, Ltd.—This company's statutory meeting is to be held on May 26th at Winchester House. The report shows that 112,911 shares have been allotted under the scheme of arrangement between the old company and its creditors and contributors, and for the remaining seven preference shares £1 each has been paid in cash. The preliminary expenses are estimated at £1,357.

STOCKS AND SHARES.

Wednesday Evening.

Until something decisive happens in the Far East, it seems tolerably certain that the Stock Exchange markets will not awaken into business activity. There is, of course, a certain amount going on, but the volume of trade has perceptibly dwindled. Investors are rather shunning the markets, although recent new issues have gone as well as could have been expected. There is a general tendency to await the course of events before taking up fresh Stock Exchange interests.

Underwriters of the Bruce Peebles Preference issue considered themselves fortunate at being left with a little under 40 per cent. of their liabilities. The prospectus appeared at an awkward moment, and the existing shares were quoted at a very trifling premium, so that the public applications can only be regarded as good. The new shares have changed hands this week at ⅛ discount. A new London County issue is said to be imminent, the money being required in connection with the Council's decision to purchase the North Metropolitan Tramways.

Marked attention has been drawn to City and South London Railway Ordinary stock, the price of which dropped on Monday to 39, and recovered this afternoon to 41. Financial guides are attributing the weakness to the reduction of fares caused by the tramway competition. This may, of course, have something to do with it, but the direct cause is a slight pressure to sell by the syndicate which took over the large line of Ordinary stock not very long ago. And a selling order in £10,000 is quite enough to put down the price a point or two, especially if it be thought that there may be another similar sum to come out after the first has been digested. Metropolitan Consolidated is duller at 93½, but Districts keep near 34, although the new holiday arrangements for the men do not meet with the unqualified approval of the staff. At 5½ Great Northern and City Preferred "A" shares are down ¼. Underground Railways profit-sharing notes are 101½, which is a point better.

Another 5s. fall brought London United Tramways Preference to their par value of 10, and the Debenture stock is being negotiated about 100½. Anglo-Argentine Trams stiffened to 8⅜, and there has been a slight rise in Barcelona Preference to 10; the Ordinary are 11½. City of Buenos Ayres Tramways are quoted at 5 13/16, and the 4 per cent. Debenture stock is being bought at 102, which seems to be quite high enough for it. Dublins are 14, but the Preference fell ½ to 15½, and British Electric Tractions are ⅛ easier at 9⅜. The dividend declaration is due next month. Westinghouse Preference do not move from 3.

Of the Ordinary shares in the Electricity Supply list only Chelseas have altered this week, with a fall of ½ to 6½, Charing Cross and City Preferences are ⅛ lower at 4 15/16, and Edmundson's Preference lost a similar fraction at 6⅛. Otherwise the fluctuations are confined to three small rises in the Debenture stocks of the County of London and the City of London Companies.

Telegraph descriptions are languid, in common with investment securities generally. The Anglo-American speculative counters have moved within narrow margins; the Deferred stock is ⅛ up at 15⅝, while the "B" fell ½ to 106. There has been a small inquiry for Amazon Debentures, raising the price a couple of points to 76½. On the other hand, Eastern Extensions lost ¼ at 14¼, and West India and Panama Preferences continue flat, the Seconds being 15s. lower at 7¼, and the Firsts no better than 8. The dividend, declaration is considered disappointing. Great Northern and Copenhagens receded to 34½, a nominal fall of 30s. Actually, the market has been duller than the official price for a week or so. Submarine Cables Trust hardened to 124½ upon United States buying, and Globes remain firm.

In the Telephone section movements are small and irregular. National Preferred is ⅛ better at 109, but the Third Preference eased off ⅛ to 5⅛. Oriental Ordinary and Preference are both *ex* dividend, and no change has occurred in the quotations. A fall of 5s. makes United River Plate Telephones 7 middle, and Chili shares have not moved from 6⅞. Telephone Co. of Egypt 4½ per cent. Debenture is called 102 to 105.

The satisfactory report of the Callender's Co., issued on Wednesday, brought about no change in the Ordinary shares, but the Preference scored ⅛ at 5⅝. Henley's are ½ better at 12. Edison and Swan have also advanced upon the circulation of vague tips to buy and Brush Ordinary, marking ⅛ decline, are *ex* the dividend of practically the same sum. Telegraph Construction gave way a further point at 35. Babcock & Wilcox settled down to 5¼, and Castner-Kellner shares improved a few pence upon the declaration of the dividend.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1903.	1903.	1904.	Closing Quotations May 10th.	Closing Quotations May 17th.	Business done week ended May 17th, 1905. Highest	Lowest
34,800	African Direct Telegraph, 4 % Debs.	100	4 %	4 %	4 %	99 —102	99 —102	100	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	2¼ — 2⅜	2¼ — 2⅜	..	..
119,700‡	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	72 — 77	74 — 79	..	..
163,582	Anglo-American Telegraph	Stock	60/6	61s.	2/6	59 — 61	59 — 61	..	..
3,118,210	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5⅔ %	106 —107	105⅛ —105⅞	106⅛	105⅛
3,118,210	Do. do. do. Deferred	Stock	1/-	2s.	Nil	15⅜ — 15⅝	15⅜ — 15⅝	15 15/16	15 15/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	..	6⅜ — 6⅝	6⅜ — 6⅝	..	..
15,000,000$	Commercial Cable	$100	8 %	8 %	8 %	230 —240	230 —240	..	..
1,932,856‡	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	4 %	4 %	4 %	97 — 99	97 — 99	99	..
16,000	Cuba Telegraph	10	6¼ %	5 %	5 %	8¼ — 8⅜xd	8¼ — 8⅜	8 1/16	..
6,000	Do. 10 % Pref.	10	10%	10%	10%	15 — 16 xd	15 — 16	..	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	3⅜ — 3⅝	3⅜ — 3⅝	..	..
6,000	Do. do. 10 % Cum. Pref.	5	10%	10%	10%	8½ — 9	8½ — 9	..	..
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	101 — 103	101 —103⅝	..	..
60,710‡	Direct United States Cable	20	8⅔ %	8 %	..	11¼ — 11½	11¼ — 11½	11½	..
78,500	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	100 —102	100 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	139 —142	139 —142	141	139⅜
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	..	91 — 93	* 91 — 93	92⅛	91⅛
1,886,814	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	107 —109 xd	107 —109	..	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	14½ — 14¾	14 — 14¼	14⅜	14 1/16
602,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	105 —107	105 —107	107	106
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	4 %	4 %	4 %	100 —102	100 —102	100⅛	..
200,000‡	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	99 —101 xd	100 —102	99½	..
180,887	Globe Telegraph and Trust	10	£3 1s 7*	5⅞%	5⅞%	10⅜ — 10⅝	10⅜ — 10⅝	10⅝	10 11/16
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	14⅜ — 15	14⅜ — 15	15	14⅜
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	15 %	24 %	35 — 37	34 — 35	35 5/16	34⅛
50,600	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,900, Red.	100	4½%	4½%	4½%	100 —102	100 —102	..	..
17,000	Indo-European Telegraph	25	10%	10 %	13 %	50 — 52	50 — 52	50⅛	..
72,680	Monte Video Telephone Co., Ltd., Ord.	1	3 %	3 %	..	⅜ — ⅝	⅜ — ⅝	..	..
1,982,382	National Telephone, Pref. Stock	100	6 %	6 %	6 %	108 —109	108⅜ —109½	109⅛	108
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	101 —103	101 —103	102⅜	101⅛
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12½ — 13⅛	12⅜ — 12⅝	13 1/16	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11⅛ — 12⅛	11⅛ — 12⅛	12⅛	..
250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	5 3/16	5⅛
9,000,000	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	100 — 102	100 — 102	101	..
1,689,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	104¼ —105½	103¾ —105½	104⅜	..
179,818	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6½%	6½%	1¼ — 1⅜	1¼ — 1⅜ xd	1⅜	..
50,000	Do. do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	1⅜ — 1½	1⅜ — 1½	1 3/16	..
100,000	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	99 —102	99 — 102	..	..
11,889‡	Reuter's	8	5 %	5 %	..	7¾ — 8¼	7¾ — 8¼	..	..
8,287	Submarine Cables Trust	Cert.	6 %	6 %	6 %	122 —125	122 —125	..	..
58,000	United River Plate Telephone	5	7 %	8 %	..	7 — 7½	6⅞ — 7⅛	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	..	5 — 5⅛	5 — 5⅛	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	107 —109	107 —109	..	..
15,609‡	West African Telegraph, Shares	10	2 %	4 %	4 %	8 — 8½	8 — 8½	..	..
80,008	West Coast of America, 1 to 80,000 and 53,001 to 53,008	2½	Nil	Nil	Nil	⅜ — ½	⅜ — ½	..	..
160,000	West Coast of America, 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	100 —102	100 —102	..	..
107,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	13½ — 14	13½ — 14	13⅞	13½
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	101 —103	101 —103	..	..
563,380	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103 —105	103 —105	104¾	..
88,821	West India and Panama Telegraph	10	Nil	Nil	Nil	⅜ — ½	5/16 — ⅜	..	..
84,568	Do. do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	8½ — 8¾	7½ — 8⅛	8 3/16	8 1/16
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	7½ — 8¼	7 — 7½	7½	..
80,000‡	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	104 —106	104 —106	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

40,000	British Aluminium 7 % Cum. Pref.	5	Nil	Nil	Nil	5 — 5⅛xd	5 — 5⅛	..	..
40,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	Nil	4⅞ — 5⅛	4⅞ — 5⅛	..	..
20,000	Do. do. 4% Funding Certs.	5	..	..	..	2⅞ — 3⅛	2⅞ — 3⅛	..	..
800,000‡	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	98 —102 xd	98 —102	..	..
133,301	British Electric Traction	10	8 %	6 %	..	9⅛ — 9⅜	9⅛ — 9⅜	9⅛	9⅜
156,487	Do. do 6 % Cum. Pref.	10	6 %	6 %	..	10⅜ — 11⅛	10⅜ — 11⅛	11⅛	..
1,000,000‡	Do. do. 5 % Perpetual Debenture Stock	Stock	5 %	5 %	5 %	121 —123	121 —123	12 2/3	12 1/2
250,000	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½ %	96 — 98 xd	96 — 98 xd	97½	97½
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	5⅞ — 6	5⅞ — 6	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	5⅞ — 6	5⅞ — 6	..	..
200,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	102 —105	102 —105	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	0 — ¼	0 — ¼	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,781	2	Nil	Nil	Nil	⅛ — ¼	⅛ — ¼	¼	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	1⅝ — 2	1⅝ — 2	..	..
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	92 — 95	92 — 95	..	..
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	79 — 82	79 — 82	..	..
85,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	10¾ — 11¼	10¾ — 11¼	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	..	..
800,000	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	107 —109	107 —109	..	..
1,963,208	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	91 — 93	92 — 94	93	91
523,396	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	101 —103	101 —103	102½	..
523,336	Do. do. Def. do.	Stock	4 %	4 %	4 %	80 — 83	82 — 85	..	..
1,880,000	City and South London Railway	Stock	3⅛%	2⅞%	2⅞%	40 — 43	42 — 43	40⅜	39
85,000	Crompton & Co., Nos. 1 to 85,000	5	5 %	2½%	..	2 — 2½	2 — 2½	..	..
100,000‡	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	5 %	5 %	5 %	¶5 —100	¶5 —100	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	Nil	..	1 — 1⅛	1 — 1⅛	1⅛	1 1/16
17,189	Do. do. "A" shares, 01—017,189	5	Nil	Nil	..	1⅞ — 2⅛	2 — 2⅛	..	..
844,038‡	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	82 — 87	82 — 87	..	..
100,000‡	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	87 — 92	87 — 92	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	..	⅞ — 1⅛	1 — 1⅛	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	..	2⅛ — 2⅜	2⅛ — 2⅜	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	4 %	4 %	4 %	96 — 99	96 — 99	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9⅞ — 10	9⅞ — 10⅛	..	..
800,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	97 —101	97 —101	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	15 %	15 %	11 — 12	11⅛ — 12⅛	12	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	5⅛ — 5⅜	5⅛ — 5⅜	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	109 —111	109 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10%	..	16 — 17	16 — 17	16⅜	16
800,000‡	Do. do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	100—103	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	1¼%	1⅜%	1¼%	3⅛ — 3⅜	3 7/16 — 3 9/16	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	9¼ — 9¾	9¼ — 9¾	..	..
27,850	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	35 — 37	34 — 36	34⅛	..
150,000‡	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	103—105	103 —105	..	..
540,000‡	Waterloo & City Railway, Ord. Stock	100	3⅛%	3⅛%	3⅛%	91 — 93	91 — 93	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List

Bank rate of discount 2½ per cent. (March 9th, 1905).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years 1902.	1903.	1904.	Closing Quotations May 10th.	Closing Quotations May 17th.	Business done week ended May 17th, 1905. Highest.	Lowest.
£		‡							
59,377	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	£	8 %	10 %	10 %	9¼ – 10¼	9¼ – 10¼	..	..
10 623	Do. do. 7 % Cum. Pref.	£	7 %	7 %	7 %	9¼ – 10¼	9¼ – 10¼	..	..
£88,782	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	105 – 108	105 – 108	..	..
80,000	Charing Cross and Strand Electricity Supply	£	10 %	8 %	8 %	7⅞ – 8⅛	7⅞ – 8⅛	8⅛	8⅛
80,000	Do. do. 4½% Cum. Pref. ..	£	4½%	4½%	4½%	5⅜ – 5⅝	5⅜ – 5⅝	5⅝	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	£	4½%	4½%	4½%	5 – 5⅛	4⅞ – 5⅛	..	..
40,000	Do. do. 1903	£	..	4½%	4½%	5 – 5⅛	4⅞ – 5⅛	5⅛	..
330,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	105 –107	105 –107	..	..
44,486	*Chelsea Electricity Supply, Ord.	£	5¼%	5¼%	6 %	6½ – 7	6½ – 6¾	6¾	..
150,000‡	Do. do. % Deb. Stock Red.	Stock	4½%	4½%	4½%	109 –111	109 –111	110⅛	..
70,595	City of London Electric Lighting, Ord. 40,001—110.595 ..	10	5 %	5 %	6 %	11 – 12	11 – 12	11 7/16	11
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	1⅝ – 1½	1⅝ – 1½	1⅝	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid ..	£	5 %	5 %	5 %	123 –127	124 –128	..	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid ..	100	4½%	4½%	4½%	103 –105	104 –106	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4¼%	8⅜ – 9⅛	8¼ – 9⅛	9	..
30,000	Do. do. do. 6 % Pref., 40,001—60 ..	10	6 %	6 %	6 %	12 – 12½	12 – 12½	12 7/16	..
400,000‡	Do. do. 4½% Deb. Stock	£	4½%	4½%	4½%	114 –114	112 –115	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	4½%	4½%	4½%	102 –104 xd	102 –104	103⅛	103⅛
70,000	Edmundson's Electric Corporation, Ord. Shares	£	7 %	7 %	..	6⅜ – 6⅝	6 – 6⅛	6⅛	..
80,000	Do. do. 6 % Cum. Pref.	£	6 %	6 %	..	6⅜ – 6⅝ xd	6 – 6⅛	6 1/16	6 1/16
800,000‡	Do. do. 4½% 1st Mort. Deb. Stock ..	100	4½%	4½%	4½%	107 –109	107 –109	109	108
21,000	Kensington and Knightsbridge Electric Ord.	£	10 %	12½ %	12 %	12 – 13	12 – 13	..	..
136,000	Do. do. do. 4 % Debenture Stock ..	Stock	4 %	4 %	4 %	101 –103	101 –103	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	£	Nil	Nil	3 %	2½ – 2⅝	2½ – 2⅝	2 3/16	..
6 i 0:0	Do. do. do. 6 % Pref.	£	6 %	6 %	6 %	5¼ – 5½	5¼ – 5½	5½	..
371,845	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	4 %	4 %	4 %	99 –101	99 –101	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	7½ %	8½%	10 %	18 – 19	18 – 19	18⅛	18⅛
76,121	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	£	4½%	4½%	4½%	5¼ – 5⅝	5¼ – 5⅝	5 17/32	5 9/32
200,000‡	Do. do. 3½% 1st Mort. Deb. Stock	..	4½%	4½%	4½%	109 –114	109 –114	..	..
250,000‡	Do. do. 3% Mort. Deb. Stock Red	Stock	3½%	3½%	3½%	97 – 99	97 – 99	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	99 –101	99 –101	99⅜	99¼
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	14½ – 15½	14½ – 15½	14⅜	14 11/16
59,000	Do. do. 4% 1st Mort. Deb.	100	4 %	4 %	4 %	100 –102	100 –102	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£	14½%	14½%	14½%	14 – 15	14 – 15	14½	14 5/16
20,000	Do. do. do. 7 % Pref. 20,001 to 40,000	£	7 %	7 %	7 %	8¾ – 8¾	8¾ – 8¾	8 7/16	..
150,000‡	Do. do. 3½% Deb. Stock Red ..	100	3½%	3½%	3½%	98 –100	98 –100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£	3½%	4 %	4 %	2⅝ – 3¼	2⅝ – 3¼	..	..
50,000	Do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	79 – 83	79 – 83	..	..
65,000	South London Electricity Supply, Ord.	£	1½%	3 %	4 %	3¾ – 4¼	3¾ – 4¼	..	..
100,000	South Metropolitan Electric Light and Power Ord. ..	£	Nil	Nil	Nil	1/16 – 1/8	1/16 – 1/8	1/16	..
50,000	(*Late Blackheath and Greenwich Dist. E.L.Co.*) 7 % Pref. ..	£	Nil	7 %	7 %	1 1/32 – 1 1/16	1 1/32 – 1 1/16	1 1/8	..
100,000	4½% 1st Deb. Stock	100	4½%	4½%	4½%	105 –108	105 –108	..	..
80,000	Urban Electric Supply, Ord.	£	5 %	5 %	5 %	4⅞ – 5⅛	4⅞ – 5⅛	4 29/32	..
80,000	Do. do. 5 % Cum. Pref.	£	5 %	5 %	5 %	5 – 5⅛	5 – 5⅛	5⅛	..
200,000	Do. do. 4½% 1st Mort. Deb. Stock Red	100	..	..	4½%	104 –106	104 –106	..	..
110,000	Westminster Electric Supply, Ord.	£	12 %	13½%	14%	12 – 13	12 – 13	12 15/16	12½
28,151	Do. do. 5 % Cum. Pref.	£	5 %	5 %	5 %	6 – 6⅛	6 – 6⅛	6 1/16	6 1/32

Shares not officially quoted :—Mackay Companies, ord., 40⅜—41⅛. Pref. 73½—74½.

*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, May 17th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£38 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£5 5	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£18	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£22	..
a Lead, Nitrate	per ton	£25	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a Potassium Bichromate, in casks	per lb.	8d.	..
a Potash, Caustic (75/80%)	per ton	£22	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	155/-	10/- dec.
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£8	..
Sodium Bichromate, casks ..	per lb.	9½d.	..
,, Cyanide	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£180	..
b ,, Wire, in ton lots ..	per ton	£168	..
b ,, Sheet, in ton lots ..	per ton	£166	..
b Babbitt's metal ingots	per ton	£48 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	7¾d.	..
c ,, Tube (brazed) ..	per lb.	9¾d.	..
c ,, ,, (solid drawn)	per lb.	9d.	..
c ,, Wire, basis	per lb.	8d.	..
c Copper Tubes (brazed)	per lb.	10¼d.	..
c ,, ,, (solid drawn) ..	per lb.	10¾d.	..
g Copper Bars (best selected ..	per ton	£79	£1 dec.

METALS, &c. (*continued*).		Latest Price.	Fortnight's Dec. or Inc.
g Copper Sheet	per ton	£79	£1 dec.
g ,, Rod	per ton	£79	£1 dec.
e ,, (Electrolytic) Bars ..	per ton	£70 10	..
e ,, Sheets ..	per ton	£87	..
e ,, ,, Rod ..	per ton	£81	..
e ,, ,, H.C. Wire	per lb.	9¼d.	..
f Ebonite Rod	per lb.	8/8	..
f ,, Sheet	per lb.	8/-	..
m German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	6/- to 7/-	..
h India-rubber, Para fine	per lb.	5/8½	inc.
i Iron, Charcoal Sheets	per ton	£15	..
i ,, Pig (Cleveland warrants)	per ton	54/10½	2/1½ inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£18 5	8/- inc.
g ,, ,, Sheet	per ton	£14 15	10/- inc.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£7 7 6	..
d Mica (in original cases) small ..	per lb.	6d. to 1/	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/8	..
p ,, rolled bars & rods	per lb.	1/1 to 1/8	..
p ,, ,, strip & sheet	per lb.	1/8	..
o Platinum	per oz.	82/6	..
e Silicium Bronze Wire	per lb.	10½d. to 11½d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£185 to £186	£2 dec.
n ,, Wire, Nos. 1 to 16	per lb.	1/8	½d. dec.
p White Anti-friction Metals—			
"White Ant" brand ..	per ton	£48 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 les. Flax	per lb.	5½d.	..
j ,, 8 ply 10 lbs. Russian ..	per lb.	4½d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4¼d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£26 17 6	..

Quotations supplied by Messrs.:—a G. Boor & Co.; b The British Aluminium Co., Ltd.; c Thos. Bolton & Sons., Ltd.; d F. Wiggins & Sons.; e Frederick Smith & Co., f India-Rubber, G.P. and Teleg. Works Co., Ltd.; g James & Shakspeare; h Edward Till & Co.; i Bolling & Lowe j Walter H. Hindley and Co., Ltd.; k Morris Ashby, Ltd.; m W. T. Glover & Co., Ltd.; n P. Ormiston & Sons; o Johnson, Matthey & Co., Ltd.; p The Phosphor Bronze Co., Ltd.

Trams and Motor-'Buses.—The remarks made by the chairman of the Brush Electrical Engineering Co, Ltd., at their recent annual meeting appear to express the view taken by practical traction people as to the relative spheres of usefulness of the electric tram and the petrol motor-'bus. "We have felt that in the evolution of the automobile we should find a public service vehicle which would prove a useful auxiliary to tramways and light railways by acting as a feeder to them and as a pioneer to the extension of the different systems. The extent to which the one will overlap the other will settle itself in due course, but it is probable that they will be allies rather than rivals, and that in the hands of active traction organisations, such as those with which we are associated, they will together prove a means by which the traffic facilities of the country will be still further improved, both for goods and passenger purposes. As large makers of rolling stock it is necessary that we should be in intimate touch with such developments. We have, therefore, taken 'occasion by the hand,' and have been already building motor-'buses possessing certain features of merit for practical purposes."

Imports of Foreign Telegraph Cables.—There was again a noticeable increase last month in the importation of foreign telegraph cables and apparatus connected therewith. The returns just issued show a total of £3,476, which brings up the value for the first four months of the year to £23,535 as compared with only £10,527 in the corresponding period of 1904.

PARLIAMENTARY.

Electric Power Bills for London.

The Earl of Camperdown's Committee, which is inquiring into the group of Bills promoted for the purpose of supplying electric power in bulk to London, resumed its sittings on Tuesday, May 9th, when Mr. Balfour Browne, K.C., opened the case of the City of London Electric Lighting Co., Ltd. He said that the Bill was one for conferring further powers upon the City of London Electric Lighting Co., with which had been consolidated the Bill of the East London and Lower Thames Valley Power Co., which was introduced into Parliament last session. On that occasion the East London Power Co.'s Bill came before a committee of the House of Commons, and was supported by many gentlemen who had supported the present Bill of the Administrative County of London Bill, among them Mr. Merz and Mr. Falconer. The Committee, however, came to the conclusion that the Bill had not sufficient financial support, and, therefore, they rejected it.

The Chairman: Did they give that as a reason?

Mr. Balfour Browne: Well, it was upon finance that they asked us to address ourselves, and when we failed to satisfy them they rejected the Bill even before calling upon the opponents, and I admit that the finance was not very strong in that particular case. Continuing, learned counsel said that the Bill was again promoted this year, and at the same time the City of London Co., which was an existing company, and which was supplying both the City of London and a part of the borough of Southwark, also promoted a Bill which proposed to establish a power supply for the whole of the industrial, or the eastern district, scheduled in the Bill of the Administrative County Co. Neither of those Bills proposed to go into the West End, but both intended to supply the eastern portion of London. The two companies—the East London and the City of London—had come together—the former having parted with their Bill to his company. The two Bills had now been consolidated, and the whole scheme was in the hands of the City of London Co. The district they sought to supply with power, comprised an area of 295 sq. miles, and in that area they proposed to do, and to do at once, what the Administrative County Bill proposed to do, and he thought he would be able to show their Lordships, that they would be able to do it sooner, more efficiently and more certainly than that new company. He had not thought it necessary to intervene much in the case of the Administrative County Bill, because very largely his case was the same as theirs, and if they had convinced their Lordships that there was a case made out for a great power supply company, supplying, first, the authorised undertakers, and, secondly, the manufacturers, in that great district of East London, then all he would have to ask their Lordships to do, was to decide between them as to which was the proper company to be entrusted with that power.

Lord Zouche: Do we understand that the City of London Co. is now supplying?

Mr. Balfour Browne: Yes.

Lord Zouche: And that the East London and Lower Thames is now amalgamated?

Mr. Balfour Browne: It is non-existent, because it has given up it's Bill entirely.

By the Chairman: The area of the City of London Co. was not precisely co-extensive with the district of the Administrative County Bill; the only difference was that there was a little bit in the Administrative Co.'s area, south of Dartford, which they did not touch. They had taken the London, Chatham and Dover Railway Co. as their boundary all the way along. Continuing, Counsel said that, as he had already observed, their area covered 295 square miles, the pieces they had left out being, in their view, absolutely unimportant, as they would never require a supply for power purposes. Their object was to supply authorised undertakers and private persons, manufacturers and others, for power purposes. In order to supply power effectively and cheaply the electricity must be produced on a very large scale, and they also knew that they must have a high load factor. They were prepared to do everything in the district that the Administrative County could do. If they could supply at the low figures that they had said they could, the City of London Co. could supply at the same price—in fact, he thought he would be able to show that they could supply more cheaply than the other company. They could do it much earlier, because they had works already in full operation. They were supplying at the present day about 10,000 H.P. of electricity for power purposes in their comparatively small district. The best proof of what they could do would be found in what they had already done. They had spent £1,105,950, which had been raised by shares, and they had borrowed £700,000 by debentures, which had also been spent, so that the total expenditure on their works at Bankside and their distributing system was £1,805,950. Under the Act of 1900 they acquired a large site at Bankside on the south side of the River Thames just opposite the city, and the present works were erected there. Those works had a plant capable of producing 22,000 KW. Their first operations were in the year 1891, and at that time they adopted the single-phase alternating current. The two works which were erected by the company—one in 1890 and the other in 1891—had been entirely scrapped, and they had concentrated upon the site at Bankside the whole of their works with the view to economy in production. Nothing, according to the view of their engineers, was more remarkable than the unwillingness of people in England to scrap anything. They knew that in America they were prepared to scrap anything in order to secure efficiency, but in this country we recognised a vested interest in effete machinery. In their case, however, they had not done so—they had thrown over entirely and scrapped two complete works for the very purpose of getting perfect works to supply electricity at the cheapest possible rate, at Bankside. That was one of the advantages that a company had over a municipality—local authorities found it almost impossible to scrap merely for the sake of efficiency. In 1898 they began the continuous current supply for the purposes of motors, and the demand increased rapidly. They made special efforts to develop that trade. On December 31st, 1900, they were supplying 1,239 KW.; on March 8th, 1905, they were supplying 7,981 KW.—equal to 10,600 H.P. The site which they had at Bankside was practically an ideal one. There was an ample supply of water for condensing purposes; the coal was brought by water alongside the works, and the works were capable of very great extension. In fact, the site was bought and laid out with a view to extensions in the future, and they thought that now was the time to extend. They proposed to put in at once, if the present Bill passed, five turbines of 5,000 KW. each, giving a total output of 25,000 KW.; that was for the purpose of supplying power at long distances. They had at the present time 62 boilers at the Bankside works, only 30 of which were used; therefore, they had in hand a surplus of 32 boilers, and for their load of 25,000 KW. they only required 25 new boilers to generate the steam. Those 25,000 KW. could upon their present site, be supplied in 1906, if they got their Bill this session, whereas in the case of the Administrative County Co. a long period would necessarily elapse before they could get the land, or raise the capital, so that they would be years ahead of the County Co. in supplying for power purposes in the eastern district of London. They were prepared to scrap a certain amount of their present works. They had a few old and small engines of 4,000 KW. capacity, and upon their site they proposed to erect these turbines of 5,000 KW., which would give a net gain of 26,000 in addition to the 25,000, so that at the end of 1907 they would have at Bankside 55,000 KW. installed and in use. Only 8,000 were at present required, and, therefore, they would have in addition to their present supply 47,000 KW. ready for the use of the public. They had a generating station at West Ham and one at Greenwich, and if they found that the power required in East London required it, they would at once proceed to put up another station at West Ham, which would cost £1,350,000, which would have an output of 125,000 KW. At the present time the City of London Co. had one great difficulty to contend with. The lighting load of the City was only for a very short time in the day, and that necessitated a very large plant for the purpose of meeting exceptional demands arising through fog. In order to equalise their load they had all along seen the great importance of having a power load, and it was with that view, that they adopted the continuous current. They had a total of 11,639 consumers, and of that number 1,286 were consumers for power purposes. As their business had gone on, their price had gone down, and practically all the economy they had been able to make by getting a better load, had gone to the consumers in a reduction of price. He placed those facts before their Lordships against the case of the Administrative County of London Co., which was simply hypothesis upon hypothesis. That company's estimates had been made in the dark, whereas in the case of his company they were speaking from actual experience; and he knew that some of the figures put forward by the Administrative County Co., particularly those referring to the works cost, could not be achieved in London. The capital cost of the present promoters would work out at £5·25 per KW. for the first portion and £7·4 per KW. for the second portion, or an average of £6·4. Naturally, their cost was very much less than that of the Administrative County Co., because they already had the site and the buildings, and a great part of the machinery. He did not, however, pretend that that was a real figure—it was fictitious to some extent, as it necessarily must be. Continuing, counsel said he should ask their Lordships to say that there ought not to be competition for the power supply, but only regulation. In the case of the Clyde Valley Bill there was a competing Bill—the Caledonian Power Bill—and the promoters of that, finding that their Bill was in jeopardy, asked the Committee to pass both. But they rejected the Caledonian Bill and passed that of the Clyde Valley, and he would ask their Lordships to adopt the same view in the present case by passing the Bill of the City of London Co., and rejecting that of the Administrative County Co. They did not want two sets of companies doing this work, neither did they want competition, which, after all, was a very rough and ready way of making people do their duty. All that was needed for the protection of the public could be obtained by periodical revision of rates. Having already spent two millions of money, he should ask their Lordships to say that they would be able to supply cheaper than the Administrative County Co., and on the question of time, he could beat them by two years at least. Therefore he should ask the Committee to give the preference to an old company rather than to one, which was proposed to be started by persons who had come from the north for that purpose. He wished it to be clearly understood that he had no wish to compete with existing companies; he thought it would be monstrous if they were allowed to go in and compete with an existing company during the period of its concession. They were prepared to put a clause in their Bill pledging themselves not to go into districts already supplied by companies, without their consent; while, however, he was not going to compete with companies, he was going to compete with local authorities, which he thought was only fair. He believed that they would be able to produce electricity at such price as would pay municipal authorities to take power from them and supply it to the public at a profit. The Administrative County Co. had said that they would put a clause in their Bill by which they would undertake to supply everybody in their district at the maximum rate. He wished to say at once that he could not make any such promise, and if the Administrative County

Co. put such a clause into their Bill, it would put an end to it, for it was absurd for any company to make such a promise.

The CHAIRMAN said he believed that the clause was to contain certain conditions on which the company was to be bound to supply at the maximum price to anybody who asked.

Mr. FITZGERALD, K.C., who appeared for the Administrative County Co., said that was the case.

The CHAIRMAN said he thought it would be to the interests of all parties, if Mr. FITZGERALD would draft a clause showing exactly what they proposed to do in the way of conditions.

Mr. BALFOUR BROWNE said that his clients would be prepared to undertake to supply everybody in the district who wanted power, but not at the maximum price. No company in the world was in a position to do better for its customers than they were, and if the Administrative County Co. were authorised to come into the district to-morrow, it could not be prepared to supply within the time that the City of London Co. could; neither could it raise its capital as cheaply as they could. His company could raise unlimited capital merely by resolutions of the shareholders, whereas a new company would have to go into the market to raise its capital at enormous cost.

Mr. FRANK BAILEY, the chief engineer to the promoting company, was then called, and in reply to Mr. Hutchinson, he bore out the opening statement of counsel. He said that the growth of the power supply of the company from December, 1900, had been very large, and that growth was still going on. As the demand had increased, so they had lowered the price. In 1903 the average revenue per KW. was £5 1s. 3d., in 1904 it was £4 2s. 10d. The average rate charged per unit for the power sold in the last quarter of the year 1904, was 1·933d., as compared with 2·238d. for the corresponding quarter in 1903. Reductions were continually in progress, and the average receipts for the present year up to date were 1·72d., and he estimated that the average for the whole of this present year would work out at about 1·4d. per unit. The total amount of plant which he would put down at Bankside at first, was five turbines, which could be put into their existing engine house. They would put down ultimately machinery of a capacity of 55,000 KW. He would say that the rate of progress in an area such as that was very uncertain, but probably in three or four years' time they would be wanting the extra 47,000 KW. The cost price at which power could be generated would be $\frac{2}{10}$ths of a penny. In the past they had not been able to get a number of railway companies to take a supply from them. They had approached the Great Eastern, Great Northern, and a number of other companies, but with increased power they would be able to meet the companies comfortably. Witness here put in plans of the works as existing and as proposed to be extended. The five steam turbines would replace that portion of the old machinery which was obsolete. There was no necessity to have any additional boilers at first, as their present boilers could supply all the steam which was necessary. Witness was then taken in detail through the various tables. He considered that there was every reason to think that there would be a great increase in the demand for energy in the East End. After Bankside had been worked, they would have ample time to erect suitable works at West Ham. In scrapping their old plant, they would deal with it by their depreciation fund of £256,758. Their capital expenditure would be £1,000,000, and they expected to spend that before the end of the year 1907. He anticipated that the works cost per unit would be ·208d., as against Mr. Mers's figure of ·154d. From what he knew of the expenses at Bankside, it was not possible to generate electricity at a less cost than 2·08d. He anticipated that the average charge would be ·7d. or less. By the year 1907 he expected they would be able to pay a dividend of 6 per cent. The works at West Ham would have an ultimate capacity of 125,000 KW., and the station would be erected in sections.

Cross-examined by Mr. HONORATUS LLOYD, K.C.: He was not satisfied with the results which had attended the canvassing for customers; he would have liked to have seen more. He admitted that part of his company's undertaking would be purchasable by one local authority in 1914, and part by another, in 1931.

Mr. Lloyd suggested that the new turbines would not be so purchaseable, but Witness thought they would be.

Mr. Lloyd pointed out that the Bill exempted from purchase any improvements made, but Witness thought that the new machinery would be purchasable if it was necessary for the needs of the locality. Taken as a whole, he admitted that the charges of the local authorities were less than those of the companies, but he thought that manufacturers would be better treated by the companies than by the local authorities.

Mr. LLOYD: But the object of the Bill is to bolster up the middleman.—WITNESS: No, I don't think that is quite right.

Further cross-examining Witness, Mr. LLOYD asked him if it was not a fact that those parts of the area where there was the greatest demand had been cut out of the Bill?—WITNESS did not think so. He could not answer questions about the financial aspect, though he understood that one of the directors would be called on that point.

In reply to Sir RALPH LITTLER, K.C., WITNESS said that he did not know that the City was dissatisfied with the supply of his company, neither did he know that they went to the Charing Cross Co.

Sir RALPH, for the City: Under this Bill you have power to take up the City streets for any purpose?—WITNESS: No, I think not.

On Wednesday, May 10th, at the commencement of the proceedings, Mr. Hutchinson handed in to the Committee a clause which had been agreed to between the promoters and the London Electric Supply Corporation. The clause provided that no competition should take place with the company without its consent. Mr. Hutchinson stated that similar terms had been offered to the South Metropolitan Electric Light and Power Co., the County of London Co., and the South London Co.

Mr. BAILEY was then further cross-examined. In reply to Mr. FREEMAN, K.C., who represents a number of borough councils, the WITNESS stated that it was the short tenure of the companies which was one reason for his not competing with them. He considered that the local authorities were in many cases supplying at a lower price than they were justified in doing, and he thought that if the accounts were audited more from an engineering point of view, that would have to be remedied. There was no competition between the local authority and the companies in Bermondsey, and he took it that there they would not be able to supply at all, owing to the difficulty of differentiating between the possible customers of the local authority and those of the company. Of course, it was anomalous. There was, he knew, nothing in the Bill to prevent customers who took current for power purposes using that current for electric lighting purposes, and as to that he would leave the local authorities to apply their own remedy.

By Mr. BAGGALLAY, K.C. (for the Charing Cross and Strand Electricity Supply Co. and the Kent Electric Power Co.): He did not know anything about an arrangement which had been settled with the Charing Cross Co., whereby that company was to seek for the northern area and the City and the promoters the area south of the Thames. Nothing had been done which was inconsistent with any arrangement, if arrangement there were. There had been no breach of faith. So far as the Kent Co. was concerned, he was willing to give them the same clause.

WITNESS was then cross-examined by Mr. RAM (for Messrs. Redpath, Brown & Co.) with regard to 7½ acres of land proposed to be taken by the promoters for the purposes of a generating station at Greenwich.

Replying to Mr. LEWIS COWARD (for the L.C.C.), who suggested that there was no more room for cables in the Blackwall and Millwall tunnels, Mr. BAILEY said that he could not agree to that. He thought that there would be room for 30 3-in. cables, if they were properly distributed in pipes.

The witness was then cross-examined by Mr. Vesey Knox on behalf of the Borough of Southwark, by Mr. Morton for West Ham, Mr. Williams for Stepney, and Mr. White for Hackney.

Mr. HUTCHINSON then briefly re-examined, and replying to counsel, WITNESS said that if the company did not supply direct in those areas where there were other companies, it would not affect the consumers, because the existing companies already had mains laid down. He considered that it was a distinct advantage to have the industrial area separate, for the effect of separation would be to have a better load, and that would mean economy. The question of the economic production of current was not in any way affected by their having three modes of generation. Economy was the result of the proper burning of coal and the use of the energy derived from the coal by proper machinery.

Mr. PARSHALL, consulting electrical engineer, the designer of many electrical installations, among them that of the Central London Railway, was then called, and said that the evolution of the power company had been a matter of great difficulty. He agreed with the last witness that everything depended upon the proper application of steam.

Mr. BRAITHWAITE, the deputy chairman of the promoting company, then gave evidence as to the financial position of the promoters. The capital of the company was £800,000, and they had an ample reserve fund of £256,758. The gross revenue for 1904 from all sources was £250,838, and it had risen to that amount by gradually increasing stages from £39,662, the amount for the first working year, 1893. Out of the present sum of £250,000, about 10 per cent. was derived from power supply. The average rate of dividend on the ordinary shares was 4·11, the rate for last year having been 6 per cent. The shareholders were an influential body, such as would be capable of finding a large amount of money amongst themselves.

Mr. FREEMAN, in cross-examination, called witness's attention to an interview which he (witness) had granted to a representative of the *Westminster Gazette*, from which interview counsel read extracts. It appeared that Mr. Braithwaite had, as a director of the promoting company, and chairman of the County of London Co., expressed the opinion of the existing companies that they could supply electricity quite as well as the Administrative County of London promoters could. Counsel suggested to witness that the position which he took up in the interview with regard to the Administrative County Bill was exactly the position which the Borough Councils took with regard to his (witness's) Bill.

WITNESS: The local authorities and the companies combined could do as well as the big companies.

On Thursday, May 11th, Mr. Braithwaite having been further examined, the Earl of CAMPERDOWN said that before hearing evidence against the Bill, he would hear the case for the Charing Cross and Strand Co.; and Mr. CLAUDE BAGGALLAY, K.C., counsel for that company, proceeded to make his opening statement.

He said that the company for whom he appeared had two generating stations, one in Lambeth, facing Somerset House on the River, and one at Bow. The Lambeth station had a capacity of 4,500 KW., and the coal for that station could be brought by rail, river, or cartage. There were two trunk mains passing over the river from that station, one of 2,000 KW. capacity passing over Waterloo Bridge, and one of 1,600 KW. capacity passing over Charing Cross Railway Bridge. Their station at Bow was supplied by coal from the Great Eastern Railway system, but there they also had the alternative of water. The Bow station had a total capacity of 12,000 KW., and they were at the present time erecting another 4,000-KW. generator, which would give them a capacity of 16,000 KW. The maximum demand on the Bow station during the past year was over 9,000 KW. The plant was all of the

most up-to-date character, and the new plant was of the very best description. In fact, he was sure that it would be difficult to find plant anywhere in a better position. Their buildings were suitable for machinery of a capacity of 32,000 KW., and they had land, on which buildings to hold plant with a capacity of another 32,000 KW. could be erected. He stated that in order to show that they were ready to meet any demand, they had four motor generating stations in the West End area.

The CHAIRMAN: They are not generating stations?

Mr. BAGGALLAY: No, my Lord, they are what are called motor generating and battery stations, really they are transforming stations.

Continuing, COUNSEL said that it was the Bow station, from which they would supply power in bulk. At that station they generated on the three-phase system, and the current had to be converted for the user. They had one of those sub-stations in St. James's Park, under the Band Stand, for the purpose of supplying that Park. And he might mention that there they were supplying two lamps which they really ought not to supply, as they were outside their area. At the present time the company were supplying in the West End area between 420,000 and 421,000 8-C.P. lamps, and they had in that area 325 miles of mains. In the City area they were supplying between 309,000 and 310,000 8-C.P. lamps, and there they had 265 miles of mains. The total supply in 8 C.P. lamps was therefore 730,000, and the total length of the mains 660 miles. The output for last year was 20,000,000 units, and up to the present time they had not been called upon to supply Stepney or West Ham. What his clients wished to do was to extend their area of supply to the North-Eastern districts of London, including Chingford, Walthamstow, Tottenham, Ilford and Romford. Some time ago the company wish to supply the Tilbury and Southend Railway Co, but they found that it could not be done, as the nearest point of any portion of the land of that company to the electric supply company's area was 14 ft. away. The only way in which it might have been done was by laying a special cable 3½ miles in length, and to supply at another point of the area. That was one reason why the company wished for an extension of their area. In conclusion, Mr. Baggallay remarked that the company were in a position to supply the increased area at once if they obtained it, but only with the consent of the Borough Councils concerned, would they supply to a manufacturer direct.

Mr. W. FLADGATE, the chairman of the company, who was then called, was taken in detail through the history of the company. The capital of the company was £3,130,000, of which sum £2,370,000 had been issued at a cost of only 2·68 per cent. The balance of £370,000 was unissued.

Cross-examined: The proposed extensions at West Ham or Bow would be made for the purposes of the Bill, and in regard to those extensions they excluded the right of purchase by the local authorities. The user of the existing works would not affect the question of the purchase of those works by the local authorities. It was true that the local authorities would probably have no generating stations to take over from the companies at the end of the period, but then the company would have been assisting the local authorities all along.

Mr. E. W. SEARLE, secretary to the Charing Cross and Strand Co., was then called. WITNESS was proceeding to make a long statement to show the effect of competition upon the local authorities, when the Chairman of the Committee interposed, and said that the Committee had heard practically the same thing from witness after witness, not only in that Bill, but in the previous Bills.

Mr. TALBOT (for the Charing Cross Co.): I should like to say that we were not here, my Lord.

Earl CAMPERDOWN: No; but unfortunately we were.

WITNESS then stated, in reply to Mr. TALBOT, that his company was prepared to deal with the local authorities in this way. They would lay down mains to the stations of the local authorities upon the local authorities guaranteeing a sum of 5¼ per cent. on the capital value of the mains. They had also agreed that they would sell to the local authorities the transforming machinery necessary upon a basis of 4 per cent. interest.

Cross-examined by Lord ROBERT CECIL: The price which his company had offered to Poplar was 2d. per unit for power.

Further cross-examined, WITNESS said that the average price in the City for lighting was now 3·05d.

On Friday, May 12th, Mr. W. H. PATCHELL, engineer to the company, was called, and said that the plant which the company had at West Ham was of such a character as would enable the company to supply the local authorities at a very cheap rate. The cost of generation was getting cheaper year by year. In 1903 the works cost of production was ·51d.; in 1904 it was ·47d.; and in 1905 it had so far been ·35d. In fact, they would be able in a few years to almost give their power away. There would be very little disturbance of the streets by the company, as they would be able to use the existing network of mains of the local authorities. He had not estimated exactly what it would cost to supply all the local authorities in the area which they asked for. He thought that the manufacturers would "rise in a body" against a local authority, which would not take electricity at a cheap rate. If the manufacturer could not get electricity, he would have to rely upon gas or steam, for it was power which he wanted, and not electricity *qua* electricity, except perhaps for lighting purposes.

Cross-examined by Mr. BROWNE, K.C.: He thought that if the local authorities charged too high a price, they would have to face the competition of gas and oil.

Mr. BROWNE: Then you don't think that electricity is always the best form of power?—It depends on circumstances; electricity is not a patent medicine, it will not cure everything.

Mr. BROWNE: You are a most picturesque witness.

Mr. LLOYD, K.C., then cross-examined witness for the purpose of proving that the witnesses' maximum charges were nearly double those of the Administrative County scheme.

Mr. LLOYD: Does your maximum charge include the cost of conversion?—No.

Mr. LLOYD: Ours does.

WITNESS said that his company anticipated that they would assist the local authorities to supply at bottom prices, but the CHAIRMAN remarked that the local authorities were not obliged to deal with his company. In reply to further questions, witness said that the average price paid for coal by his company during the last quarter was 13s. 5d. per ton.

In reply to Mr. RICKARDS, for the Walthamstow U.D.C., Mr. PATCHELL said that he knew nothing about Walthamstow.

At the conclusion of witness's evidence, the CHAIRMAN said that the Committee had decided to postpone for the present the hearing of the opposition against the Bill.

Mr. BROWNE, K.C., then opened the case for the Metropolitan Supply Co. He said that the case would take very little of his Lordship's time. The Bill was to confer further powers on the company. The company supplied at the present time, the whole of the district of Paddington. Counsel then at some length went into the history of the taking over by the Marylebone Council of part of the company's undertaking. The company, however, still supplied part of the district of Marylebone from their large station at Willesden. They supplied the Borough Council in bulk, but Marylebone was erecting a generating station itself, and would in time, no doubt, supply itself all together. The company's station at Willesden was too large for their purposes, and it was with a view of utilising that station that they had brought up the present Bill. They wished to utilise their station and their capital in supplying the surrounding local authorities in bulk in their various areas. They also sought for power to supply electricity for traction purposes only to canal and railway companies. He emphasised the words "for traction purposes only," as there were no such limitations in the other Bills. The Westminster City Council and the London County Council were opposing the Bill, and with regard to the former he thought that they had no right to be heard, for the dispute was of the smallest. At the present moment there was a small portion of the City of Westminster within their area of supply, and they had, of course, power to break up the streets in the City for the purposes of their undertaking. The City Council seemed to think they would be breaking up their streets for other purposes. The company did not propose to do anything of the kind.

The CHAIRMAN: Do you propose to take any part of Westminster which you have not at present?

Mr. BROWNE: No, my Lord, we do not.

The CHAIRMAN: Have you power to break up streets in any part of Westminster, or only in the part in which you supply?

Mr. BROWNE: We have power to break up streets in any part of the City, but I do not think that we shall want to do anything further than that, as we have no area of supply beyond Westminster. We will consider if an arrangement can be come to with Westminster. Continuing, Counsel said that at Willesden the company had 16,000 KW. ready and waiting for customers, and, in conclusion, he dealt with the opposition of the L.C.C., which was on the question of the possible breaking up of sewers and other matters, and asked the Committee not to allow the *locus* of either the Westminster Council or the L.C.C.

The CHAIRMAN said that the Committee had decided to allow the *locus* in both cases.

Mr. CONACHER, the general manager of the Metropolitan Electric Supply Co., was then called, and gave a brief history of the company's Acts and provisional orders. The total capital of the company was £3,000,000; their share capital being £1,500,000. The total capacity of the company's generating plant was 19,200 KW., and in three or four months' time that would be increased by 3,000 KW. Of the 19,200 KW., 1,700 were in Marylebone, and that plant belonged to the Borough Council, and was worked by the company as the Council's agents. A further 2,000 KW. was at Sardinia Street, and would be taken over for the purposes of the new street improvements by the London County Council on June 1st next. The area which his company proposed to supply was one in which they would not infringe anyone's right to supply in bulk. There were in the area four local authorities who had power to supply in bulk in their own areas. They were the Acton, Ealing, Harrow, and the Heston and Isleworth Councils.

The CHAIRMAN: But I thought that you would not infringe anyone's right to supply in bulk?—WITNESS: No, my Lord, we shall not.

WITNESS said that it was not the intention of the company to supply current for lighting railway stations in the extended area. They would supply for traction purposes only.

Cross-examined by the Hon. J. D. FITZGERALD, K.C. (for the Administrative County Bill promoters): They obtained their coal at 12s. per ton, and they obtained part of their water from the Metropolitan Water Board. He would not admit that the lowest price of his company was the maximum price proposed by the Administrative County scheme. The works cost of 1·36d. per unit was the figure for last year before all their machinery was up. He thought that when he gave that figure to the Committee in March he said that it was for the previous year.

Cross-examined by Mr. FREEMAN, K.C.: He did not seek to supply any authorised users besides the railway and canal companies. The company were quite willing to make it clear that they had no intention of supplying workshops of railway companies or similar works.

Mr. FREEMAN put it to witness that his company was really trying to get a price for a concern which it had already sold to the Marylebone Council. In Marylebone itself it would be supplying

really in competition with the Borough Council.—Witness would not agree to this.

Re-examined by Mr. RAM, K.C.: So far as the Middlesex portion of the scheme was concerned, it had been under consideration long before anything was heard of the Administrative County scheme. In the case of a supply, say, to the Railway at Paddington, they would supply only for purposes of traction, and would not supply for the lighting of the station. Supply for traction would, of course, include the lighting of the train.

Mr. JARRATT, chairman of the Acton U.D.C., gave evidence as to his Council having laid its own distributing mains, and as to its taking its supply from the Metropolitan Electric Supply Co. Their arrangement with that company had 27 years to run.

Mr. EDGAR COUSINS, clerk to the Hampton U.D.C., having also given evidence in support,

Mr. BROWNE said that he had other witnesses, but he did not think it would be necessary to call them.

The case for the opposition was then taken.

Mr. WORDINGHAM, consulting engineer, having briefly given evidence to the effect that he saw no advantage in the company having power to supply over the proposed area,

Mr. FREEMAN, K.C., addressed the Committee. He contended that there was no necessity for such a general Bill in a district where there were few railways, and where what railways there were would take any supply they wanted from the local authorites. He also contended that if the company got their Bill it would mean that one local authority would be prevented from supplying another.

The Hon. J. D. FITZGERALD, addressing the Committee on behalf of the Administrative County promoters, remarked that the three companies, the Metropolitan, the Charing Cross, and the City, were practically attempting to get the whole of London under their control. Their proposals had been made when the Administrative County scheme was "on the stocks," and he contended that the action of the three companies was merely intended to block the progress of his clients. The charges which the companies would make were uncertain, whereas if the Administrative scheme was passed, the consumers would be assured that they would not be charged more than the maximum price in their schedule. Further, under the sliding scale, 1d. per unit was the standing rate at which they could distribute a dividend of 8 per cent.

The CHAIRMAN: And that is a good sound dividend?

Mr. FITZGERALD: It is so. Counsel continued that the sliding scale was a good thing for the consumer.

Mr. CLODE then addressed the Committee very briefly for the L.C.C. He remarked that the Bill would in all probability stand in the way of some larger scheme.

The CHAIRMAN: What do you mean, Mr. Merz's?

Mr. CLODE explained that he meant some scheme by the County Council and the local authorities.

Mr. Browne, K.C., was about to address the Committee, in reply to Mr. Fitzgerald, when Mr. FITZGERALD objected that counsel had no right to reply, as he (Mr. Fitzgerald) had not called any witnesses.

Mr. BROWNE: No; but you have put in a plan.

Mr. FITZGERALD began to explain his position, and referred to the practice of the Committee rooms, when

Mr. BROWNE: My learned friend's remarks are not worth answering. The Committee then adjourned until Monday.

On Monday the Committee sat at 12 o'clock, when Sir RALPH LITTLER, K.C., opened the case for the North Metropolitan Electric Power Co.'s Bill. He remarked that it was originally intended to have a very much larger area than that in the present Bill. They had intended to include Islington and Hackney, but they had now been struck out, because the company did not consider these parts of the area to be of any great importance, and also because they wished to keep down their own expenses. Hackney did not object to being struck out, and did not appear against the Bill. Islington, on the other hand, did object. There was another clause which had been struck out, that which was to empower the company to supply outside local authorities, and in substitution of that clause they had inserted another which limited their power to supplying local authorities, or other authorised undertakers who *adjoined* their area. It might well be that some authority adjacent to their area might want a temporary supply in the case of a breakdown, and it was for this purpose only that the clause in question had been inserted. He drew their Lordships' attention to the similarity between that clause and the clause which enabled the old London water companies to supply one another in cases of emergency. It was merely to enable them to exchange supply. Their existing area of supply contained 324 sq. miles, and included the whole of Middlesex east of Willesden, and a large part of the County of Hertfordshire. Their Act of 1902 authorised them to supply in that area provided that they did not enter into competition for ordinary purposes of supply with the local authorities. They now proposed to add Stoke Newington to that area. Further, they sought power to supply electrical energy to railways, and in explanation of this Sir Ralph mentioned that the Hertfordshire and Essex County Councils had a scheme for a system of light railways, which the company hoped to supply with energy. The local authority of Wood Green was opposing the Bill in respect of the proposal of the promoters to supply electricity to the Alexandra Palace trustees. West Ham was also opposing on the question of the supply of energy to railways.

Mr. JAMES DEVONSHIRE, the chairman of the promoting company, was called, and corroborated learned counsel's statements in regard to the area of supply, &c. The company's power station had a capacity of 3,000 KW., and they had room for large extensions.

Cross-examined by Mr. FREEMAN, K.C.: His company had had an application from the North-East London Railway Co., for a supply, if they (the railway company) got their Bill. He admitted that they had had no application from existing railway companies.

Cross-examined by Mr. MADDISON (for Wood Green): His company already had powers to supply the grounds of the Alexandra Palace, but special powers were needed to enable them to supply the Palace buildings, as they were not within the company's present area.

Re-examined: Their clause with regard to supplying the railways, did not include the words "lighting the carriages," but it would be absurd for one person to supply the power for the train, and the other the light for the carriages.

Sir DOUGLAS FOX, consulting engineer to the North-East London Railway promoters, put in plans showing the route of that railway. He said that whether their Bill was passed or not, there would sooner or later be a Bill passed to authorise some such railway in that district. It was better for a railway of that character to take its power from a company than to generate its own power. The station of the company was conveniently situated for supplying the railway when constructed. In the case of the Great Northern and City Railway, they had had to generate their own power as they could not get it elsewhere.

Cross-examined by Lord ROBERT CECIL, K.C.: The Great Northern and City Railway Co. did not ask any of the local authorities to supply them, as none of those authorities was in a position to do so.

Mr. BALFOUR BROWNE, K.C., said that he had the engineer to the Lea Conservancy and the manager of the Regent's Canal Co., both of whom would say that they wished to take power for haulage from the promoters.

The CHAIRMAN said that perhaps they might call the engineer to the Conservators, if the opponents wished to cross-examine.

Counsel for the petitioners said that they had no wish to prolong the proceedings by a cross-examination of that witness, and

The CHAIRMAN said that there was therefore no need to call the witness.

Mr. H. BURT, the vice-chairman of the Alexandra Palace Trustees, said that it would be most inconvenient for them to generate their own electricity, and that they must look for their supply to some outside body. They wished to take a supply from the promoters.

Cross-examined by Mr. MADDISON (for Wood Green): The Trustees of the Palace had considered estimates for the putting in of their own plant, but that was some years ago.

This concluded the case for the promoters.

Mr. MADDISON (for Wood Green) then addressed the Committee. He said that the powers asked for by the company were exceptional in every way. At the present moment the Wood Green District Council were empowered by provisional order, ratified by subsequent Acts, to supply electricity both for power purposes and for lighting purposes; and under the Acts of the promoters they (the Council) were also empowered to go to them (the promoters) and obtain a supply in bulk. It was unfair that the company should enter into competition with the District Council by taking one of their largest consumers. It prevented the Council from bargaining in the way they ought to be able to bargain.

Mr. G. M. REID, chairman of the Electric Lighting Committee of the District Council, was called to show that the Council had done all they could to start their electrical undertaking.

Mr. FREEMAN, K.C. (for Shoreditch), then dealt with the substituted clause relating to the supply of energy to railways. He said that, although a supply might be given for haulage, it might, when it got into the hands of the customer, be used for lighting purposes.

Mr. SAUNDERS (for Islington) said that, although that borough had ostensibly been struck out of the Bill, yet the company proposed to do indirectly what they proposed to do originally under Clause 4 (the clause which being struck out, left Islington out of the scheme). Islington was really not struck out at all, because it had been placed in again by another clause, which enabled the company to supply in adjacent areas.

This concluded the case for the petitioners, and the Committee reserved their decision.

The case for the Central Electric Supply Co., Ltd., was then opened by Mr. BALFOUR BROWNE. He said that the company was formed some years ago because two companies, the St. James' and Pall Mall and the Westminster, had come to the end of their tethers. The two companies in question promoted a Bill to establish a company for the purpose of erecting a large generating station on the Regents' Canal from which they might derive their electricity for their peak loads. The company then formed, now wished to extend their powers so that they might be enabled to supply authorised distributors in St. Pancras, Marylebone, and that part of Westminster which was supplied by the St. James' and Pall Mall and Westminster Companies.

The L.C.C. and the City Council of Westminster both opposed the Bill, and Mr. Balfour Browne objected to the *locus* of the former body.

Mr. BLENNERHASSETT, K.C., who appeared for both bodies, said that it would be a very serious precedent if that body was not allowed a *locus*. The Bill involved questions of the greatest importance, and the L.C.C. were interested not only in the questions of streets and sewers, but in the question of electricity supply.

The Committee conferred, and the EARL OF CAMPERDOWN announced that the Committee had come to the decision that the *locus* of the L.C.C., must be restricted to the questions of streets and sewers.

Mr. EDMUND BOULNOIS, M.P. for East Marylebone, and chairman of the Central Co., was then called, and having briefly given evidence in support of the Bill, the Committee adjourned.

(To be continued.)

Metropolitan Pneumatic Dispatch Co.'s Bill.

On Friday last the Court of Referees, under the Chairmanship of Mr. Parker Smith, considered the claim of the Electric Lighting Co.'s of London, to be heard in opposition to the Bill of the Metropolitan Pneumatic Dispatch Co.

Mr. Moon, K.C., who appeared for the Electric Lighting Companiess aid the Bill was of a novel character. The purpose was to incorporate a company for the purpose of dealing with parcels in the whole of the county of London. It was proposed to lay tubes under the streets, through which parcels would be propelled by compressed air, and this could be done by motors actuated by electrical energy, which would be derived from a generating station in the neighbourhood of Hammersmith. It was also proposed to provide air-pressure machinery worked by electricity for the conveyance of parcels in shops. The grounds upon which he claimed a *locus* were several, and competition would be one of them. First, however, he based his claim for a *locus* on the fact that the company proposed to take power for the alteration of the position of electric mains and wires, &c., which were under the public streets. By Clause 36 the company took power to transmit and convey electrical energy from a generating station to any pneumatic line under the powers of the Gas Works Clauses Act. He claimed that the electric lighting companies ought to be heard before Parliament gave powers to a company whose objects might prove delusive and impracticable. His second claim for a *locus* was on the ground of competition. The company proposed to lay down tubes in the public streets for the dispatch of parcels to all parts of London.

Mr. Brynmor Jones, M.P., asked what a pneumatic tube was, for he could not quite see how the question of electricity came in.

Mr Moon said the air pressure was obtained by motors worked by electricity, and the company was proposing to carry electricity about for the purpose of working these motors, and to break up the streets for that purpose.

Mr. Worsley Taylor, M.P.: It is limited for pneumatic purposes, is it not?

Mr. Moon said the electricity could be used for lighting the premises of the promoting company. They proposed to have 223 stations in London, and took powers for lighting them.

The Chairman: It is a curious kind of competition. They do not take powers to sell electricity.

Mr. Moon: They do indirectly. They get the value of the electricity they supply to themselves.

In reply to a question, Mr. Moon said there were a great number of petitions against the Bill, including the L.C.C. and some of the Borough Councils. Another point with regard to competition was that the promoters proposed to supply pneumatic tubes and motors to shops for dispatching parcels from one department to another.

Mr. Brynmor Jones: Supposing instead of using electricity they used a gas engine at every point, you would have no *locus* at all.

Mr. Moon: No.

Mr. Jones: Then surely your *locus* only comes with regard to the breaking up of streets?

Mr. Moon said that the electric lighting companies could show that they could supply the electricity required at less cost than the promoters, and that there was no use in their being given powers.

The Chairman said if the promoters used gas engines the electric lighting companies could not prevent them.

Mr. Moon said that then they would not want Parliamentary powers.

Mr. Jones said that supposing he was the owner of a great mansion in London, and for some reason did not care to deal with any of the electric lighting companies in his immediate neighbourhood, he might promote a Bill to obtain a supply from a company 10 miles out of London. He did not suppose he would get his Bill, but he would like to know if Mr. Moon thought the electric lighting companies would have a *locus* on the ground of competition?

Mr. Moon: Most decidedly. It would enable an outside company to compete with me.

Mr. Jones: But only on my premises?

Mr. Moon: It is true that it might only apply to your premises, but I imagine that no such power would be sought unless a considerable amount of energy were required. There can be no doubt but that unless this Pneumatic Dispatch Co. is altogether a delusion, it would use a very considerable amount of electricity.

Mr. Worsley Taylor: Do you say they would have power to supply other people?

Mr. Moon: Indirectly.

Mr. Ferre (Parliamentary agent for the promoters): I distinctly join issue with you there.

Mr. Moon said that if the company only took powers for themselves, he would still claim that he was entitled to be heard. If the promoters did not get the powers to generate, then he could supply them with electricity. It was true that there were cases where railway companies had generated electricity for themselves, but it was where the electric lighting companies had not been in the position to do what the railway companies could do for themselves.

Mr. Taylor asked if the electric lighting companies could come in where a railway company came with a Bill to Parliament?

Mr. Moon said the railway company simply came with a money Bill, to expend a certain amount of capital on electricity, and it was a domestic matter between the company and the shareholder.

Mr. Taylor said that, so far as this company sought power to supply its own premises, it was surely a domestic matter.

Mr. Moon said he would put it in this way: First, they required Parliamentary powers to obtain premises, and then they proposed to do a thing which the electric supply companies could do at less price. The electric companies had all their mains laid, and could easily give a supply.

Mr. Jones: That only means that you want to compel them to become your customers.

Mr. Moon said he would not object to it being put like that. He asked that the companies he represented should be allowed to show there was no reason for giving the Pneumatic Co. the powers they sought, because his companies could do what they wanted to do. The promoters were asking to be allowed to set up machinery for the manufacture of electricity in the areas of the electric lighting companies, and certainly he thought they had a right to be heard before Parliament granted the promoters such powers.

Mr. Jones thought that competition as they used the word was where there were two traders ready and willing to render the same service to the various classes of persons they came into contact with, but the promoters did not want to supply electricity to the persons the electric lighting companies dealt with.

Mr. Moon said they were proposing to supply themselves. They were potential customers of the electric supply companies.

The Chairman: But I can supply electricity from my own house if I like.

Mr. Moon: They ask for Parliamentary powers.

Mr. Taylor: But they do not want Parliamentary powers except to break up streets.

Mr. Moon: They require Parliamentary powers to get premises and erect a generating station and lay mains and wires and so on. At any rate, they propose to take Parliamentary powers.

Mr. Jones: But in what sense is this company a rival trader with you?

Mr. Moon: Because they propose to supply themselves with electricity.

Mr. Jones: That is contradictory to the elementary principles of law. No man can contract with himself.

Mr. Moon: They are selling a commodity which their customers who use the tubes will pay for. Further, they propose to take power to provide motors and pneumatic tubes for dealing with shops and premises which otherwise would take their power from the electric supply companies. One of their chief purposes is the provision of electric machinery in shops.

Mr. Jones: Have any of the petitioning companies the power to do any of these things.

Mr. Moon said the companies could supply power to enable the shopkeeper to do it for himself. That was the serious grievance they had. For instance, Debenham & Freebody took a considerable amount of power from one of the electric lighting companies.

Mr. Taylor said the promoters could not use their electricity except for a certain purpose.

Mr. Moon said it was the kind of business that the electric supply companies looked to get a great deal from in the future. They knew that at the Waverley station at Edinburgh all the carrying was done by electricity.

Mr. Jones asked if any of the petitioning companies actually supplied electricity for carrying parcels from one railway station to another?

Mr. Moon said he could not actually say they did, but electricity was being very largely used in docks and warehouses.

The Chairman said that without this Bill at all, the promoters could supply pneumatic tubes to Debenham & Freebody, and get electricity by going to the electric lighting companies. By the Bill, however, they were enabled to supply this electricity themselves.

Mr. Balfour Browne, K.C., for the promoters, said it was not intended to provide anyone with power. No Act of Parliament was required to enable them to install pneumatic tubes at Harrod's Stores, and if Harrod's asked them they could install electric plant for working them. The fact was that the electric lighting companies wanted to capture a customer. This concern, if successful, would be an enormous one, and would require 32,000,000 units of electricity per annum. It might be that they would find it more economical to take that electricity from existing companies or local authorities, but they wanted to buy in the cheapest market, and did not want to be compelled to take it from any particular company.

The Chairman said the promoters were asking for power to break up streets and interfere with other people's wires and pipes, and so on. These powers were given by Parliament to undertakers of proved utility. Here the promoters came in with a new and unproved scheme. Was it not their business to establish themselves as a matter of public utility before they asked for the same rights with regard to other people's property that these people had?

Mr. Balfour Browne said he did not dispute that the electric lighting companies were entitled to a limited *locus*, and to protection, so far as their property was concerned. He agreed also that Parliament would never sanction his Bill, unless he could prove utility. It was not, however, for the electric lighting companies to come against them.

After further argument, the Committee considered the matter in private, and eventually allowed the petitioners a full *locus*.

Afterwards the Committee considered the application of the Metropolitan Railway for a *locus* on the ground of competition, and also allowed this.

The company's Bill came before a Select Committee on Tuesday. Our report is held over.

Glasgow Corporation Tramways.

The inquiry at Glasgow was resumed on 8th inst. when the Commissioners dealt with the Glasgow Corporation (Tramways) Consolidation Order. There was a large array of counsel on behalf of the promoters and the opponents of the Order.

Mr. E. T. Salvesen, K.C., Solicitor-General, on behalf of the promoters, said the object of the Bill was to consolidate the various Acts which the Corporation had already obtained—16 in number—as regards tramways within and without the city. They proposed to ask for no powers except those they already had in connection with the existing tramways. They desired that these powers should be carried into the area in which they sought to have tramways constructed. Some of them were objected to. The objections were all of a similar nature. In the first place, there was a general objection of competition by the railway companies which, so far as he knew, had never yet been successful. The railway companies, however, had also special objections in respect that they had frontages along some of the streets where it was proposed to make some of the tramways on the ground that those thoroughfares were too narrow to admit of a double line. There were also special objections which, however, it seemed to him were not to the preamable but rather to clauses, such as where the tramway lines would cross under or over a railway undertaking. The proposed extensions might be distinguished thus—those which were entirely within the municipal boundaries, and those which were partly within and partly without. As regarded the former, counsel thought the Commissioners would not listen to any objections against the preamble. The object of these tramways was to connect the diverging spokes of a wheel so to speak. The system was constructed on the footing of having a common centre from which there were lines radiating towards the circumference. By clauses 69 and 70 the Corporation were empowered to carry parcels, goods, and articles up to 500 lb. weight. They had power to carry passengers' luggage up to 28 lb., and as the clause was rather vague they proposed this alteration. They were only asking the power they obtained in connection with the Clydebank Tramways. They were asking power to run luggage tramways. If it was proper on the Clydebank Tramways it should be proper on the other lines. It was desirable that the word "parcel" should be defined, and that there should be some limit in weight.

Mr. James Dalrymple, manager of the Glasgow tramways, said that the present system extended to 158 miles, 98 being inside and 60 outside the city. The proposed extensions would cover 17 miles inside the city and 13 outside, measured by single track. Witness was taken over each line in detail. With regard to the powers for carrying parcels, he thought that Glasgow should possess the same power as other municipalities, and he believed that if the Corporation decided to exercise the power it would be largely taken advantage of.

Cross-examined by Mr. Constable, advocate for the County Council of Renfrew, witness said with regard to the clause for carrying parcels, he could not say how it was proposed to distribute the parcels. They were simply asking for power, and this matter had never been considered in any shape or form.

Councillor Hugh Alexander, convener of the Tramways Committee of the T C, corroborated generally Mr. Dalrymple's evidence.

On resuming on Tuesday, the 9th, the Chairman, Mr. Eugene Mason, intimated that the Commissioners would like, if counsel would give information regarding the sums spent and borrowed by the Corporation in connection with the cars, in addition to the money necessary for the proposed extension. He explained that the request was made in accordance with the terms of a letter from the chairman of the House of Lords Committee.

Evidence for the promoters was afterwards concluded.

Before the adjournment the Commissioners gave their decision with regard to the extensions. All of them were granted with the exception of the Cunniesburn Toll line, but permission was given the Corporation to extend the present line from Maryhill to Garscube Bridge.

On resuming on Wednesday, 10th inst., the parcels-carrying and omnibus running proposals were dealt with. The Commissioners sanctioned the parcel-carrying clause, with the condition that the Corporation must first get the sanction of the County Council ere adopting the power contained in the clause so far as Renfrewshire was concerned.

Clause 45 dealing with the running of omnibuses was allowed with the promise that the powers, except in the case where the running of cars is interrupted, shall not be exercised beyond a radius of 3 miles from any point on the tramways, and shall not, without the consent of the Board of Trade, be exercised in the case of any one road for a longer period than one year.

London Tramway Bills.—A Select Committee of the House of Commons, consisting of Mr. Kearley (chairman), Sir E. Greene, Mr. Parkington and Mr. Stroyan, has been appointed to consider the L.C.C. (Tramways), the Metropolitan Electric Tramways, and the London Southern Tramways Bills.

Metropolitan Electric Supply Co (Acton District) Bill.—The Lord Chairman of Committees reports that all opposition to this measure has been withdrawn.

Scotch Electric Lighting Provisional Orders.—The Clyde Valley Electrical Power Co. has deposited a petition against the confirmation of the Rutherglen Order and the Grangemouth Gas Co. against the Grangemouth Order, both contained in No. 4 Confirmation Bill.

Mexborough and Swinton Tramways Bill.—On May 11th this Bill was before the Unopposed Bill Committee of the House of Commons, and was ordered to be reported for third reading.

South Lancashire Tramways Bill.—All opposition to this Bill has been withdrawn.

Accrington Corporation Bill.—The opposition to this Bill, which has already passed the House of Commons, has been withdrawn.

Hastings Tramways Bill.—This Bill came before a Select Committee of the House of Lords on May 11th, but, as no parties appeared in opposition, it was referred to the Unopposed Bill Committee.

Tyneside Tramways and Tramroads Bill.—This Bill was before the Unopposed Bill Committee on May 11th. The Committee struck out a clause in the Bill dealing with the carriage of parcels, and with this amendment it was ordered to be reported to the House.

Metropolitan District Railway Bill.—On May 11th the above Bill came before the Chairman of Ways and Means as an opposed measure, and was ordered to be reported for third reading.

Electric Lighting Provisional Orders.—The Kingston-on-Thames Gas Co. has deposited a petition in opposition to the Confirmation Order for Surbiton; the Hessle Gas Light and Coke Co. is opposing the Hessle Order; and the Potteries Electric Traction Co. have petitioned against the order authorising an extension by the Burslem Corporation to Tunstall. All three orders are contained in No. 5 Confirmation Bill.

Bills Read a Third Time.—In the House of Commons on May 11th the following private Bills were read a third time:—Baker Street and Waterloo Railway Bill, Charing Cross, Euston and Hampstead Railway Bill, Edgware and Hampstead Railway Bill, and West Cumberland Electric Tramways (Extension of Time) Bill.

Electric Lighting Confirmation Orders (No. 6) Bill.—This Bill came on Monday before Mr Campion, the Examiner, for proof of compliance with Standing Orders. The Bill confirms orders to the North Metropolitan Electric Power Co. in respect of the Urban District of Barnet; to Messrs. Christy Bros. & Middleton for the Rural District of Brockenhurst; to the Farnham and District Electric Supply Co. in respect of Farnham; to the Gosport and Alverstoke Electric Light Co. in respect of Gosport and Alverstoke; amending the Houghton-le-Spring Electric Lighting Order, 1904; to Foote & Milne, Ltd., in respect of the City of Lichfield; to Wm. Norton in respect of the Borough of Ludlow; to Foote and Milne, Ltd., in respect of the Urban District of Lytham; to the St. Albans & District Electric Supply Co., in respect of portions of the Rural District of St. Albans; and to the North Metropolitan Electric Power Co. in respect of Ware. The Bill was ordered to proceed.

Electric Lighting Confirmation Orders (No. 7) Bill.—On Monday the Examiner found the Standing Orders had been complied with in regard to the above Bill. It confirms Orders to the local authority of Bishops Stortford; to the Dover Corporation in respect of the Rural District of Dover; to the Hemsworth Electricity Supply Co. in respect of part of the Rural District of Hemsworth; to the Marlborough Electric Supply Co., Ltd., in respect of the Borough of Marlborough; to the Lancashire Electric Power Co. in respect of the Urban District of Tollington; and to the Woking Electric Supply Co. for an extension of their area of supply to the Urban Rural Districts of Chertsey.

Shepton Mallet Gas Co. (Electric Lighting).—This Bill, which empowers the Gas Co. to produce electricity and erect works for that purpose within the limits of their gas supply, came before the Unopposed Committee of the House of Lords on Tuesday, and was ordered to be reported for third reading.

Chelsea Electricity Supply Co. Bill.—On Tuesday this Bill came before the Unopposed Committee of the House of Lords, when the preamble was proved.

L.C.C. Tramways.—The Standing Orders Committee of the House of Commons met on Tuesday, and considered the petition of the L.C.C. for an additional provision to their Tramways Bill. They sought to include in the Bill a clause giving them Parliamentary sanction to lay down temporary rails for the purpose of maintaining the service of tramways in any street in which a tramway of the Council in course of adaptation or reconstruction for working by electric or other mechanical means. The Committee decided to report to the House against the Standing Orders being dispensed with.

Weybridge and Walton-on-Thames Electric Supply.—On Tuesday this Bill, which authorises the Urban Electric Supply Co. to lay mains and supply electric energy from the generating station at Weybridge to Walton-on-Thames, came before the Unopposed Bill Committee of the House of Lords. Formal evidence having been given in proof of the preamble, the Bill was ordered to be reported for third reading.

Electric Automobiles in Germany.—The report for 1904 of the Allgemeine Betriebs-Actien Gesellschaft für Motorfahrzeuge, of Cologne, which is a manufacturing company for the supply of electrical vehicles, states that the public has begun to appreciate the advantages afforded by electric motor-cars for service in the town and environs. As a consequence, not only has the proposed cab service in Berlin been brought into existence by the formation of the Electromobile Co., in which the Cologne company is interested, but the latter has also sold 27 vehicles to important firms for business purposes. As the company, before everything else, has to meet the wishes of the public, its principal attention, the report states, should not be solely directed towards the realisation of profits. Nevertheless, if all the orders on hand had been completed in 1904, the year would have closed with a profit. The cabs in operation at Cologne yielded a profit of £272 last year, and the prospect exists of making the service considerably more remunerative in the present year. The gross profits of the company amounted to £858 as compared with £805 in 1903, but after meeting expenses and depreciation, the final result is a loss of £1,158, which has been carried forward. Negotiations are proceeding in regard to various new orders, and it is believed that a favourable course of business is in prospect, especially as the company has succeeded in becoming more closely associated with the Paris firm from which it obtained a licence.

THE CURTIS STEAM TURBINE.

On Friday last, by the courtesy of the British Thomson-Houston Co., Ltd., we were privileged to see the Curtis steam turbine in course of construction and in operation at their Rugby works. In view of the important part which this type of turbine is destined to play in the generation of electrical energy in this country, a few notes relating thereto may be of interest.

At the time of our visit there was a considerable number of turbines passing through the shops, in various stages of construction, and there were three on the test bed, of which two were running. One of the latter, a 1,500-KW. set, generating at 11,000 volts three-phase, was destined for the Thornhill power station of the Yorkshire Electric Power Co., where two similar sets are already in position.

We have in previous issues fully described the construction of the Curtis turbine*, and therefore a detailed description is here unnecessary. The accompanying cross-section shows the construction of the latest type, as manufactured at the British Thomson-Houston Co.'s works at Rugby.

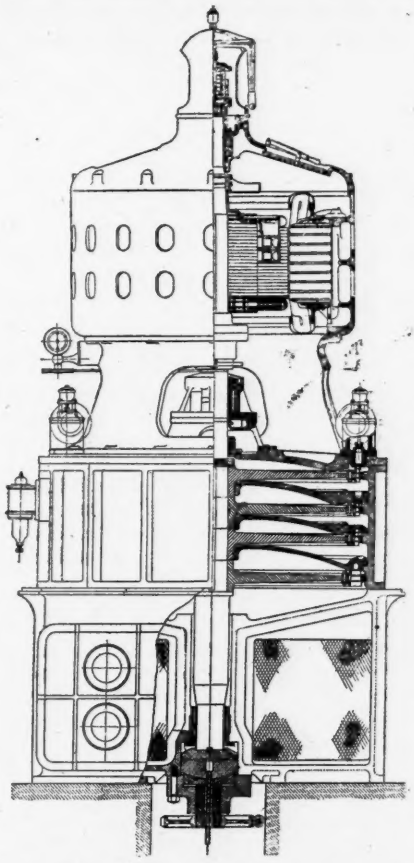
The Curtis turbine is of the impulse type, in which the velocity imparted to the steam by expansion in diverging nozzles is absorbed by a succession of stationary and revolving vanes forming a "stage," followed by further expansion and velocity absorption in later stages. The object aimed at in dividing up the velocity absorption in one stage between several sets of vanes is simply to reduce the velocity of the moving element, whilst retaining the relative velocities of the steam and the vanes at or near the proportion which, according to theory, is the most efficient. Seeing that the pressure is the same on both sides of each bucket ring, the construction of the turbine is simplified and improved, and ample clearance can be left between the moving and stationary vanes, without fear of loss of steam by leakage. The latter loss can only take place at the joint between the fixed diaphragms separating successive stages and the main shaft; this joint is, therefore, of small circumferential length, and can be made so as to restrict the loss to the utmost. In the figure the turbo-generator is shown mounted direct upon a surface condenser; the condenser, however, may be separate, standing by the side of the turbo-generator, as in the Thornhill machines, or otherwise arranged, and, of course, jet condensers may be employed.

It will be observed that the disks which carry the bucket-rings are tapered in section from the centre to the circumference, in accordance with the requirements of theory to give the maximum strength at all parts, together with stability. The bucket rings are bolted on the edges of the disks, and are manufactured with the greatest care. In order to ensure homogeneity, the rings are made from nickel-steel ingots, which are expanded to the required diameter and then cut up into slices to form the rings; there is thus no weld in the ring, no "grain" except a circumferential one, and practically no tendency to warp. To absolutely preclude the latter possibility, the rings, after being roughly machined, are heated to a temperature higher than any that they will ever attain in working, and any slight deformation which may ensue is then removed in the final machining.

The buckets, or vanes, are cut out of the solid edge of the ring by machines of most ingenious design, such as, we believe, have never previously been called for. It was most interesting to see these curious tools—masterpieces of machine design—at work upon the rims of the steel rings; the cutting tool is given a combination of four or five distinct motions, and leaves the vane correctly shaped both back and front. The operation is necessarily slow, as only one tool can operate upon a ring at a time, and there are some hundreds of teeth in each ring; nevertheless, the enormous advantage of having the vanes absolutely solid with the rim of the ring is regarded as being of sufficient value to compensate for the expenditure of time.

The rim is made slightly thicker than the finished vanes, so that the latter lie $\frac{1}{16}$ in. below its surface; the stationary vanes, which are cast in sections, of gun-metal, are similarly constructed, so that there is a space of $\frac{1}{8}$ in. between the two rows of vanes, even when the rotor is let down upon the stator, and stripping of the vanes is thus rendered impossible. Strips of steel are riveted on the outer ends of the vanes, forming a continuous shroud, and closing the ends of the buckets. The stationary vanes are beautifully cast, so that very little machining is necessary.

The diaphragms are perforated with slanting holes forming divergent nozzles, in the stages after the first, the number of such nozzles increasing with the number of stages, so that in the lowest stage, where the steam is below atmospheric pressure, almost the whole circumference of the bucket ring is acted upon by the steam. The vanes in the later stages are also much longer than in the earlier ones, to allow for the greater volume of the steam at the reduced pressures. The casing surrounding the disks and carrying the stationary vanes is made in four or more sections, which can be removed independently, thus permitting access for inspection to be gained to the vanes of both classes, without interference with the generator. It is interesting to note that the rotor has repeatedly been allowed to come down on the stator whilst running, in order to observe the effect; but owing to the shrouding arrangement above described, no harm was done whatever.



1,500-KW. CURTIS TURBINE, WITH SUB BASE CONDENSER.

The weight of the rotor is carried upon a large disk, keyed to the foot of the main shaft, and supported upon a film of water supplied under pressure by hydraulic pumps. There is no appreciable axial pressure due to the steam impinging upon the vanes; the Curtis turbine is in this respect unlike the reaction type. The water pressure required is therefore the same whether the turbine is at rest or running on load. The water, after lubricating the footstep and lower guide bearings, passes into the exhaust chamber, and is removed with the condensed steam. The friction of the rotor is so small that it can be rotated with the hand. All the bearings, including the footstep, can be removed without disturbing either the turbine or the generator. The clearance between stator and rotor, which is regulated by the footstep, can be adjusted by means of screw gear under the latter, and small inspection holes are provided in the turbine casing to enable the clearance to be observed without removing a section of the casing.

* ELECTRICAL REVIEW, February 26th and March 4th; and June 24th, 1904.

The method of governing the Curtis turbine, by means of a series of electrically-controlled valves acting on the admission nozzles, has already been fully dealt with in our pages; it has the advantage that the full pressure of the steam is utilised at all loads, and a high efficiency is maintained at light loads. In addition to the main governor, an emergency governor is provided to prevent runaways.

The armature of the A.C. generator is in the main similar to the ordinary type, with suitable modifications; the rotating field magnet, however, is of totally different construction. The central part or core consists of steel laminations provided with projections, which interlock with corresponding projections on the outstanding pole-pieces, and in addition stout metal bands are carried over the ends of the coils and keyed into the central core. The coils are wound of thin copper strip on edge, in two layers, separated by an air-space, and are held by the pole-tips in addition to the bands above mentioned. The pole-pieces themselves are also laminated, and very ample provision is made for the ventilation of the field magnets and armature.

In the case of D.C. generators, the commutator is reinforced by steel rings shrunk on over insulating bands; carbon brushes are used.

Much more might be said of the Curtis turbine, but space forbids. We may only add that the workmanship is of the highest quality; that the materials employed are no less excellent goes without saying, for inferior materials would not endure the running conditions of a turbine. The vibration experienced, even when standing on the turbine itself, is insignificant, and the noise comparatively small.

We were pleased to see that the turbo-generators were being manufactured in their entirety at Rugby—a fact which in itself is a guarantee of good quality and workmanship; moreover, while German and American machine tools have successively been tried at the B.T.-H. works, it is satisfactory to know that British tools have been found to excel all others, and are being installed as occasion offers.

Regarding the rest of the interesting sights that we observed, we can only refer in passing to the lamp factory, which is now in full swing, and turns out 26,000 lamps per week; the various processes are largely carried out with the aid of mechanical contrivances, manipulated by girls, and it may be of interest to add that the servant-girl problem has now reached a most painfully acute stage in Rugby and the adjoining neighbourhood. Interesting examples of switchgear for extra-high-pressure alternating current systems, and motors, dynamos, &c., of various types were also to be seen. In the power station a 500-KW. Curtis turbine was running at full load, and the line voltage of the Rugby Corporation supply system was controlled by the Tirrill automatic regulator, of which a description appears elsewhere in this issue. The voltage chart recorded on the main switchboard exhibited a regularity that would delight the heart of the station engineer, in spite of the variations of load due to large motors in the town. But we must close this note, recommending those who have the opportunity of visiting the B.T.-H. works on no account to miss it.

Lead v. Iron-Nickel Accumulators.—The formation of a German company to work the new Edison battery has induced the Berlin Accumulator Works Co. to issue an explanation, in order to reassure its shareholders that their interests are not likely to be prejudicially affected by the new arrival. It is submitted that the iron-nickel accumulators in question compare so unfavourably with lead batteries in regard to price and good proportion that the former are out of the question for stationary work, which forms the Berlin company's principal market. As obvious from recent statements, it is only thought to employ Edison batteries for transport purposes, and particularly for electric automobiles. Nevertheless, according to investigations, which have hitherto been conducted, the iron-nickel battery both in respect of weight and space required is considerably behind the modern lead accumulator for such purposes, and it will, the explanatory statement continues, still remain far behind, from an economic point of view, even if the durability be unlimited, but the latter point is entirely contradicted by the trials made by the Berlin company with original Edison cells and by others associated with it. The Berlin company declares that experimental work has been carried on in its laboratory in the same direction for several years past, and if progress should be made which would remove the absolute lack of economy of Edison cells, the company would be able to take an active part in the development.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

8,994. "Improvements in electric switches or connectors." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) April 28th.

8,996. "Improvements in electric arc lamps." E. R. GROTE and M. V. ELY (trading as Foster & Co.). April 28th.

9,057. "A new or improved electric water-heating apparatus or radiator." L. BINKO (trading as the Electric Heating Co). April 29th.

9,064. "Improvements in electric switches or circuit-breakers." THE BRITISH THOMSON-HOUSTON CO., LTD., and E. J. MURPHY. April 29th.

8,759. "Electric distant gas-lighting device." A. MAUTZ. (Date applied for under Patents Act, 1901, April 27th, 1904, being date of application in Germany.) April 26th. (Complete.)

9,003. "Improvements in and relating to electrically-driven rotary hair brushes." J. G. LEMON. April 28th.

13,736A. 1904. "Improvements in apparatus suitable for detecting electrical oscillations." J. A. FLEMING. May 2nd.

9,088. "Improvements in dyeing and stripping of wool, silk and other fibres by the use of electricity." H. A. FLEET and S. ROBERTS. May 1st.

9,101. "Improvements relating to electrical connections." P. H. JONES. May 1st. (Complete.)

9,107. "New or improved method of constructing or manufacturing electric traction cells, accumulators and electric storage or secondary batteries." G. SCHAULL. May 1st.

9,110. "Improvements in and distribution of electricity." A. SWEET. May 1st.

9,118. "Improvements in dynamo-electric machinery, by means of which a constant voltage may be produced at varying speeds." J. H. ST. HILL MAWDSLEY. May 1st.

9,120. "An electric periodical switch." A. FREY. (Date applied for under Patents Act, 1901, August 3rd, 1904, being date of application in Germany.) May 1st. (Complete.)

9,134. "Improvements in and connected with the charging and discharging of secondary batteries applicable to electric train lighting installations." J. STONE & Co., LTD., and J. R. QUAIN. May 1st.

9,161. "Watertight electric lamp for motor-cars." C. E. CLARK. May 2nd.

9,181. "An improved electric light candle fitting." H. HIRST and J. H. COLLINGS. May 2nd.

9,216. "Apparatus for purification of water by electrical means." J. S. ZERBE. (Date applied for under Patents Act, 1901, May 2nd, 1904, being date of application in United States.) May 2nd. (Complete.)

9,257. "Improvements in and means for the electrical regulation of the speed of internal combustion engines." MARQUIS A. DE DION and G. BOUTON. (Date applied for under Patents Act, 1901, December 23rd, 1904, being date of application in France.) May 2nd. (Complete.)

9,274. "An improved device for preventing accidents through the breakage or dislocation of overhead electric wires." G. PORRITT. May 3rd.

9,279. "Improvements in apparatus for controlling the supply of energy from alternating-current generators to alternating-current motors." A. P. WOOD. May 3rd.

9,296. "Improved trolley wheel for use in electric traction." F. BAMFORTH. May 3rd.

9,303. "An improved electric switch or protective circuit-breaker." L. R. GLEASON. May 3rd.

9,344. "New or improved electric current motor." J. KRUYSWIJK. May 3rd. (Date applied for under Patents Act, 1901, May 5th, 1904, being date of application in Germany.) May 3rd. (Complete.)

9,346. "Improved construction of electric accumulator for small arms." A. E. DAKHYL and A. GALANTI. May 3rd.

9,347. "Improvements in systems of control for magnetic clutch speed changing gears applicable more especially to self-propelled vehicles." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) May 3rd.

9,363. "An electro-magnetic release for photographic shutters." F. N. GASQUOINE. May 4th.

9,401. "Improvements in electric contact devices." J. J. WALKER. May 4th.

9,405. "Improvements in electro-magnetic switch-operating mechanism." F. T. KITT. May 4th. (Complete.)

9,430. "Improvements in electrical switches or circuit-breakers." THE BRITISH THOMSON-HOUSTON CO., LTD., and E. J. MURPHY. May 4th.

9,431. "Improvements in vapour electric apparatus." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) May 4th.

9,439. "Improvements in fireproof casings and covers for electric conductors." H. R. ROMNEY. May 4th. (Complete.)

9,447. "Improvements in the electrolytic refining of copper." THE METALS CORPORATION, LTD., and S. COWPER-COLES. May 4th.

9,448. "Improvements in and relating to the electrolytic deposition of metals." S. O. COWPER-COLES. May 4th.

9,455. "Combined curb-stone and electric wire conduit." W. J. DONOHUE. May 4th. (Complete.)

9,467. "An improved method for equalising electrical power, when the power required is of an intermittent or variable character." R. BRAUN. May 5th. (Complete.)

9,475. "Improved door for electric switchboard." J. MCALLISTER. May 5th.

9,479. "Improvements relating to the electric lighting of railway carriages and other vehicles." THE ELECTRIC AND ORDNANCE ACCESSORIES CO., LTD., and R. F. HALL. May 5th.

9,481. "Improvements in or relating to electrically illuminated signs or advertising devices." P. B. W. KERSHAW. May 6th.

9,489. "Improvements in or connected with dynamo-electric generators and motors." W. W. HOWE. May 5th.

9,501. "Improvements in or relating to incandescent electric lamps." N. S. TENNANT. May 5th.

9,508. "Improvements in skates or collectors for electrically-driven vehicles operated by any surface contact stud system." R. BROWN. May 5th.

9,522. "Improvements in electric resistance furnaces." J. F. BOTTOMLEY and A. PAGET. May 5th.

6,542. "Means for automatically operating the points of slot-conduit electric tramways." W. A. LAWRENCE. May 5th.

9,543. "Improvements in or connected with primary batteries." R. J. CROWLEY and A. W. MACLEOD. May 5th.

9,565. "Apparatus for making and breaking electric circuits." F. SMITH. May 6th.

9,577. "A portable hand electric battery." B. SEACOMBE. May 6th.

9,584. "Improvements in or relating to terminals or connectors for electrical conductors." A. CORDEROY and J. F. PANNELL. May 6th.

9,602. "Improvements in electricity meters." S. MATTHEWS. May 6th.

9,607. "Improved method of and means or apparatus for controlling electric switches and like apparatus in electric current distributing systems." G. C. FRICKER. May 6th.